Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LIII. NEW YORK, THURSDAY, APRIL 1, 1909. No. 14.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....590 Old Colony Building
CLEVELAND OFFICE.....1015 Schofield Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico	per year,	$3.00
Dominion of Canada	" "	4.50
Other Foreign Countries within the Postal Union	" "	6.00
25 shillings.	25 marks.	31 francs.

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Thursday of the same week.

Copyright, 1909, by McGRAW PUBLISHING COMPANY.

Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1908 was 898,000. Of this issue 24,000 copies are printed.

NEW YORK, THURSDAY, APRIL 1, 1909.

CONTENTS.

Editorial 763
Conference on Standard Electrical Rules 768
Revision of National Electrical Code 768
Annual Report of the American Telephone & Telegraph Company 769
A New Chicago Telegraph Company 770
Iowa Electrical Convention Program 770
New Jersey Public Utilities Legislation 771
Conservation of Natural Resources 771
Report on Transportation Subways in Chicago 772
Brookline Lighting Committee Reports Against Municipal Ownership 774
Proposed Railroad Subways in Chicago 776
Award of John Fritz Medal 777
N. E. L. A. Convention Exhibits 777
Third Annual New York Electrical Show 777
Chemical Extinguishers for Electric Fires 777
Boston Edison Employees' Club 778
Current News and Notes 779
Plant of the Lee Electric Light Company at Clarinda, Ia 781
Wiring of Babbitt Soap Factory at Babbitt, N. J 783
Power Station Without Operating Attendant 786
Grounded Secondaries. By W. J. Canada 786
Energy Costs in a Small Turbo-Engine Plant 789
Line Poles Purchased in 1907 790
German Central Station Statistics and Proposed Taxation of Electrical Service 790
Comparative Energy Costs in Two Central Stations 792
Low-Grade Fuels and the Power Plant. By C. M. Ripley 793
Coal Specifications 794
Employer's Liability—Fellow-Servant Rule. By John Edson Brady 795
Suggested Patent Law Amendments 796
Storm and Lightning Protection to Line Wires. By T. W. Poppe 797
A Peculiar Meter. By F. J. Murman 798
Pipe-Hangers—II. By W. H. Wakeman 799
LETTERS ON PRACTICAL SUBJECTS 801
QUESTIONS AND ANSWERS 805
The Electric Automobile at Rockford, Ill 806
Business-Getting Methods of the Edison Electric Light & Power Company, of Amsterdam, N. Y. By William H. Stuart 807
Result from Tungsten-Lamp Street Lighting 807
Electric Refrigeration in a Dairy. By R. L. Lloyd 808
Standards for Gas and Electric Light Service in Wisconsin 809
Practical Photometry 811
The Use of Tungsten Lamps from the Illuminating Engineering Standpoint 811
Electric Signs on Atlantic City's Boardwalk 813
LETTER TO THE EDITORS:
A Much-Needed Investigation. By William A. Del Mar 814
Digest of Current Electrical Literature 815
New Apparatus and Appliances 819

TELEPHONE STATISTICS.

The annual report of the American Telephone & Telegraph Company, of which we give an abstract elsewhere, is a most interesting document and most encouraging from the general standpoint of electrical industry. It is to be noted that during a year when economy was the order of the day, when declines in production and consumption were reported universally, this great system actually increased its gross income from $120,753,200 to $127,117,200, a gain of not less than $6,364,000. This is probably unique among large American enterprises last year. The United States Steel Corporation showed a decline of 36 per cent in gross and 43 per cent in net. The main inference is that the telephone industry is remarkably stable in bad times, and that good management had its effect. The "Independent" opposition last year was certainly not less vigorous and energetic than before. The entire Bell system, including Canada, had an income of just $140,000,000, or an increase of $7,000,000, almost to a dollar. Such figures are cheerful reading to all who believe in the even greater future lying before our electrical industries.

It is to be noted also that there was an increase in the number of stations of 179,712, making 3,215,245 straight-out Bell stations. In addition there were found to be connected into the system 1,103,144 exchange and toll stations operated by various sub-licensee, co-operative, rural and other companies. "Independent," but not necessarily opposition, making a total of 4,364,629 stations connected to the Bell network, a total gain over 1907 of no fewer than 525,629 stations. The total of exchange connections is put at a few short of six billions. The average number of daily calls per station in the United States was about six. It would appear from the income that the average yield per message was a little over 2 cents. The yield per station was about $39.50, just a shade less than in the previous year, whereas the large increase in the number of stations would have predicted a bigger drop. The recent census figures show for the whole industry in the United States a decline from $36.62 per station in 1902 to as low as $30.15 in 1907. This is due, of course, to the enormous increase in rural stations. The Bell system has had comparatively fewer of these, but it is obvious that with so large a growth it is holding up to a very high average yield. It is here that the effect of general depression is indicated, if anywhere. Last year Bell rates, as well as Independent rates in many places, were improved and the process of shifting to a higher price for the service is certainly in evidence throughout the country.

The stability of the Bell telephone system being well established by these data and by the conditions about as well as anything can be, the question remains as to the power inherent in it of growth and expansion. It is said that the system could have exhibited even greater growth last year if it had not been rather severely purged of "poor-pay" subscribers and

of "no-pay" stations due to the earlier crises of insensate competition. This appears to be true, and, if true, leaves the system in very sound shape for the next step forward when times are better and when the commerce of the country turns from reviving hope into resuming activity. How far from real "saturation" the telephone industry of the country is at this moment we do not know, for the telephone habit is still growing, and seems susceptible of further cultivation. The question is whether the industry being so stable in dull periods it may not now be less responsive to prosperous times than in the past. We rather doubt the implication, but must after all wait for the answer until the dinner pail and ice pail are full again.

Electric Lighting Development.

The conditions in the electric lighting industry are reflected in the statistics afforded by the forthcoming April half-yearly issue of the *McGraw Electrical Directory*. It will show a present total of 5264 companies and municipal plants in the United States, and 5740 including Canada, Mexico and the West Indies. These figures compare with 5015 and 5464 in the corresponding edition of last year, for the North American Continent. This shows a gain for the period of 276 plants. In itself this is an appreciable advance for a year of depression and stagnation, but does not quite tell the story. During the last half year, as the compilers, we have made an effort to check up what may be termed the loss. This had not been done before. In other words, it appears that 60 plants had been absorbed or purchased in the six months just past, or had undergone a kindred change, while 17 had been consolidated; and 20 names were taken out for various reasons, such as failure to complete the plant, etc. Here is a rough measure of the mortality, which in later issues it is hoped to determine more precisely. As a matter of fact, 195 new names are given in this issue for the United States and 20 elsewhere, as compared with last October.

Of the total 5740 plants included, no fewer than 3193 carry electrical supplies, which implies the handling in the aggregate of a very large quantity of electrical material. As many as 4154 of the plants have alternating current, while apparently 1669 are direct. How many "overlap" is not quite clear. The spread of alternating-current methods is shown to be astonishing. Of the plants enumerated, 125 report themselves as pure transmission, while 594 others are either lighting and transmission, or else include railway work as well. Some of these are essentially transmission plants, but it becomes increasingly difficult to distinguish them because of the growth of closer relationships and of common ownership.

Illinois has still the largest number of plants, 398, though outside of Chicago few of them are of considerable magnitude. New York has 358 and Pennsylvania 346, the last State gaining 14 in the six months, which is rather remarkable for so settled a commonwealth. Ohio has 289, Michigan 253, and Texas the large number of 228, surpassing Indiana with 218 and Iowa with 207. Oklahoma has already 76 and New Mexico 15. The largest gain in the half-year is in New York, with 17, which compares with the 14 in Pennsylvania, and would indicate that to the newcomer, public service commissions may not be so terrible after all. As a matter of fact, the gains are distributed all over the country, few States being without some new enterprise of this kind reported.

Grounding the Secondary.

Elsewhere we present an able review of the grounded-secondary situation from Mr. W. J. Canada, whose position in the insurance field gives his opinion much weight. It has long been well understood that grounding the secondary is the only effective means of preventing fatal accidents from leaks through to the low-tension side from the high-voltage distributing wires. Such occurrences are, unhappily, by no means uncommon, whether due to faulty insulation of transformers or to crosses between primary and secondary wires, directly or via foreign objects. If the consumer's circuit is thus charged, the usual insulation in lamp sockets and wires is apt to be of very little avail and a touch at an incandescent lamp may prove instantly fatal. As apparatus has been improved such risks have in a measure diminished; yet the records of every year show deaths from this cause in discreditable numbers. For the last decade there has been, therefore, a steady tendency to adopt the one measure of protection that is likely to be effective in nearly every case—so to ground the secondary circuits as to put the primaries effectively to earth in case of a cross. The more progressive engineers have preached grounding in season and out of season, and the better class of central stations has already adopted the precaution as a matter really of public necessity. Some stations, little to their credit, hang back. Just what excuse to his conscience a station manager can make after his neglect of grounding has cost a townsman his life it is a bit difficult to understand. But the real cause of neglect is generally parsimony. It costs something to make a good ground and the delays and uncertainties of the law make it perhaps cheaper to kill a neighbor now and then than to protect him from danger.

The ostensible reasons for neglecting grounds are as Mr. Canada recites them: increased fire hazard, increased maintenance of transformers, and the difficulty of getting good grounds. The first named is evidently of little weight to judge from the attitude of the Fire Underwriters, whose opinion carries great weight as to the facts. The second and third are simply pleas to avoid expense. As Mr. Canada points out, there is a distinct risk of fire due to neglect of grounding, a risk certainly considerable enough to offset any risks due to grounding. And while the Underwriters do not feel justified in penalizing conditions that affect life hazards only, they are quite willing to go to the length of advising grounding. The Edison Illuminating Companies have already expressed themselves in favor of making grounding mandatory, and the A. I. E. E., while it has failed to meet the present issue fully and this year neglected to give it any attention, has more than once been recorded in favor of grounding. The chief difficulty seems to be that the question of life hazard is without the direct field of action of the Fire Underwriters, and the engineering societies have no effective means of enforcing their opinions save by the individual influence of their members, already thrown in the right direction. The N. E. L. A. has not met the issue squarely, but passed half-hearted resolutions which, very properly, were summarily vetoed last week by the Underwriters' representatives. It is the one body able to exercise the most considerable influence upon central-station practice in general. What excuses has it to offer for neglecting its duty in the matter of safety precautions? We see no reason for discrimination between secondary voltages in the matter of grounding unless it is prepared to admit that the higher secondary voltages are in

such measure dangerous to life as to require and receive insulation also effective for the primary voltages. If this is so then the high secondary voltages must be clearly recognized as dangerous and safeguarded, if used, by precautions far more difficult to carry out than any grounding. As to danger to apparatus, the replies received by Mr. Canada to his letters of inquiry make it evident that this risk is practically negligible. Transformers are better made and insulated than they used to be and are fully able to meet the conditions of grounding.

The practical question of importance to every user of electricity is how to enforce such regulations as will assure him safety. What is the readiest means of enforcing a universal rule for grounding secondaries? Mr. Canada believes that the time has come when the Underwriters should take stronger action, reinforced by the municipal authorities wherever possible and, if need be, by the Federal Government. It seems very doubtful to us whether this last step would be a practicable one, as the tendency is to leave such matters in the hands of the States. The States, however, might with advantage legislate on the subject, especially since a statute could bring pressure to bear on local authorities to make the actual grounding a thing readily accomplished. There has been at times a tendency for local authorities to put minor obstacles in the way of getting suitable grounds to an extent that has sometimes been decidedly annoying. The main thing, however, is to bring pressure to bear on the stations that hesitate about making the change to a grounded system. Probably the thing most effective in pushing these lagging folk into line would be for the engineering bodies interested in good construction, and particularly the A. I. E. E., to go squarely upon record as holding ungrounded secondaries to constitute culpable negligence on the part of the company operating them. Action of such sort would make a successful defense in case of accident practically impossible, and would go further to remedy the difficulty than anything save rather drastic legislation. We hope, too, that this year the U. E. L. A. will take an unequivocal stand in the matter and throw the whole weight of its influence in favor of safe construction. It is lamentable that the long line of fatal accidents has not been cut short ere this. If there were grave reasons against grounding one would hesitate perhaps to put the case so strongly, but as a matter of fact the objections are now practically all based on unwillingness to spend the money necessary for the work. In the case of a public service corporation and the safety of the public, such objections cannot be given much weight, and when, as in this instance, the sums involved are not large, as construction accounts go, there is no adequate excuse for delaying or dodging the issue.

A Chronometrical Joke.

It would be an interesting task for the psychiatrist to endeavor to analyze the state of mind of the promoters of the so-called "Daylight Saving Bill" which has again been advanced a stage in the House of Commons and is now before a special committee. We in this country are used, to be sure, to the introduction in Legislatures and Congress of bills involving every degree of mental incapacity and moral obtuseness, but they are generally killed in committees, and rarely advance to the dignity of a hearing. Some very unwise concessions to fanaticism are, to be sure, passed, when they are not too strongly opposed by the lobby, yet the really wild and impossible ones seldom survive the committee hearings. In the House of Commons they seem just now to be taking with owlish solemnity a proposition which one can scarcely believe is really much more than a practical joke, like the bills sometimes reported and passed in the last half-hour of merriment at the end of the session of a State Legislature. The proposition is briefly to compel the setting forward of all clocks in the British Isle from April, this bogus time reckoning to continue in force until the third Sunday in September in each year. By this beneficent arrangement the dear public is to be deluded into getting out of bed and to work an hour earlier than usual during the summer months, thus saving a clear hour of daylight and an hour of artificial lighting in the evening. It would be instructive to know the real origin of this scheme, which came up first a year ago and is now enjoying a second lease of life. Did it originate with some thrifty Scot, who had a grudge against the gas and electric light companies, or was it devised by the old women of both sexes who cannot sleep in the morning for fear of losing opportunities to mind their neighbors' business?

It would seem to be logical to include in the Bill provision for a general rising bell, to be rung for half an hour from theoretical 5:30 a. m. in every parish in the United Kingdom; also a suitable curfew to prevent ungodly folk from trenching on their due hours of sleep by sitting up too many hours after the official retiring time. Without wishing to interfere in the manners and morals as regulated in foreign parts, we would call the attention of friends of this bill to the enthusiastic way in which some of our yellow journals carry out a similarly forehanded scheme by publishing 10 p. m. extras at 4:30, thus rendering it needless to sit up late for the receipt of news. It may be well, too, to indicate to our prohibitionist friends the practical gain in saloon closing time to be thus simply attained. In fact, why not legislate that 30 minutes constitute an hour, and double up the days? This should accord well with trade-unionist views and might make a suitable rider for the bill under discussion. A waggish English journal suggests that it might be well also to legislate on the question of temperature, directing all thermometer scales to be slid upward 10 deg. on the third Sunday in April, and downward an equal amount on the third Sunday in September. The beneficent applications of this sort of thing seem well-nigh limitless. Its unofficial application to pure numerics has already worked wonders in the death rates in some of our Western cities, and in bills for municipal supplies a similar process has lightened the heart of many an alderman. We fear that the game is not wholly original, although its present beautiful development strikes one as novel. Frankly, we trust that the present bill will pass, as the greatest advertisement (barring the suffragette movement) of the new century, and as fresh evidence of the far-sighted astuteness of the body that annually turns down the Metric bill. The Lords can be trusted to suppress it or to amend it into some form yet more facetious. Meanwhile, people will keep up the same old game of getting up about when they please, working as long as they please, and then turning night into day, to the profit of the dispensers of liquids and lights.

The Modern Alchemist.

Another manifesto from Professor Ramsey announces the apparent transmutation of several things into carbon. It is one of the announcements above which might appropriately be placed the old scare-head line, "Important If True." We hope it will not prove as illusory as the former report of the same investigator concerning lithium. The fact is, however, that it is high

time in the progress of events for some of the so-called elements to be broken up. It is a long time now since their structural similarities have been self-evident and since the probability of splitting some at least of the "elements" into their components has been strong. We put aside cases like radium and its allies on the ground that they are not in fact known as metals at all and cannot be discussed from the same standpoint as the ordinarily known elements. We also put aside cases like iron in which the enormous complexity of the spectrum and many anomalous points of behavior indicate exceptional structural properties. The ordinary rank and file of the elements show plain evidence of similar structure running particularly through elements of the same group, reinforcing the obvious teachings of the periodic law itself. The spectroscopic evidence alone is immensely convincing, so that there is every reason to expect that ere long some group will yield and tell the story of its elemental structure. The question in this particular instance is whether the thing has really been done or whether the announcement rests on the somewhat shaky kind of evidence as in the report of last year. Carbon is a rather commonplace sort of breakdown product, especially when nothing is said of other constituents, and from the first reports it is quite impossible to gather anything about the weight of the evidence.

If it is purely spectroscopic, obtained from traces observed in a vacuum tube, one cannot lay great stress upon it. Vacuum tubes long used and hard pushed may show traces of very queer things relating to their past history. If on the other hand Professor Ramsey has made anything like a decent yield of carbon from bismuth or anything else of his list, he has certainly achieved a remarkable success. A most interesting question is regarding the rest of the products observed. The atomic weight of carbon is not a sub-multiple of that of Professor Ramsey's sources, and hence something else, known or unknown, must have turned up. If so, what? However this may be, it is worth while saying a word or two about the situation with a view of correcting some popular errors. Assuming that Ramsey has actually broken down a pure metal and obtained carbon from it, what does the fact mean? Assuredly it does not imply the transmutation of elements in the ordinary sense of the word. It does not mean that a pound of one thing has been changed into a pound of another. It rather means that a so-called element of rather complex structure has been broken up and has yielded at least one known substance which it may or may not have contained as such. For example, one "cracks" by heat a heavy paraffin oil and obtains from it some coherent fragments of its structure in the shape of light hydrocarbons and also products that were not part of the original substance but merely constructed of its parts in course of the reaction. The basis of organic research is so to treat a complex substance as to split it up without too much disintegration into recognizable fragments. From their relations and proportions one can make a shrewd guess as to the way the parts went together in the original material. Another splitting operation by a different method may give confirmatory evidence, and finally the point is reached where the structure of the original substance is quite clear. Then, and really not until then, there is a fighting chance for building it again out of the stuff that has been recognized as suitable building material.

Load Factors and Costs.

Central-station men generally recognize that the yearly load factor (that is, the average load for the year divided by the maximum load for the year) has an all-important influence on the cost per kw-hour of producing power. It is not always easy to show prospective customers how important this matter is, although with proper presentation it is a simple business proposition. As was recently brought out in a discussion of this subject in Chicago, electric power companies generally assume in making up their schedules of rates that the maximum demand of any customer will be during the period of the maximum peak load of the year. As a matter of fact, this may not be true in many cases, and may give rise to some injustice to certain consumers, but in a large system it is almost impossible to deal with such matters except by the wholesale. In small companies almost any of the ordinary motor loads is likely to be on during the maximum peak of the year. In large companies the diversity factor begins to help out the central station. In fact, central-station power rates would have to be considerably higher than they are were it not that there is considerable diversity in the hours of demand of power users. Were it not for this diversity there would be no logical reason for charging less for electric power than for electric light. Under conditions as they exist the very fact that a considerable part of the total power load will not be in operation at the time of the station peak justifies a lower rate than for lighting, because a large per cent of the lighting load is sure to be on during the December peak load. Of course, as regards the investment in transformer, meter and service lines near the consumer's premises, the maximum demand of the consumer governs the investment, regardless of the hour at which his maximum demand occurs; but when it comes to feeders and station-capacity investment, this part of the investment is determined by the aggregate demands of the various consumers at any one time, and in the case of intermittent power service this is considerably less than the sum of the maximum demands of the various consumers. Were it not for this fact the fixed monthly charges to small intermittent users of power would have to be considerably higher than they are at present. It is encouraging to see how the larger a central-station system grows, the greater the diversity of its load and the less the overlapping of maximum demands of various consumers.

The Future of Free Lamp-Renewals.

There is a decided difference of opinion among prominent central-station men at the present time as to a free lamp-renewal policy. The free renewal of carbon-filament lamps has been the rule rather than the exception among the larger electric-lighting companies of the United States, and the practice has also extended to some of the more progressive smaller companies. The reason for this is primarily to prevent consumers from placing poor and inefficient lamps in use and then blaming the company and electric light in general for the poor results they obtained. Now that the tungsten lamp has come into general use some managers have felt the policy would gradually be discontinued, as at present prices tungsten lamps are entirely too expensive for free renewal by central-station companies, and the consumer, recognizing this, buys his own lamps without complaint. With the tungsten lamp in use in all sockets where efficiency counts for much, naturally some question may arise as to whether it is worth while for the

central-station company to supply free renewals of the old carbon lamps used in the less important sockets of a consumer's installation. On the other hand, there are central-station men who firmly believe that the tungsten lamp has not materially altered the situation as regards the necessity for protecting the consumer against the cheap and inefficient lamp. At the present time the American-made tungsten lamps are pretty much all of one quality and efficiency, although varying considerably each side of rated wattage and candle-power. As time goes on it is thus logical to expect that the history of the carbon lamp will be repeated with the tungsten lamp and that cheap tungsten lamps with long life and correspondingly low efficiency will be retailed by hardware and other dealers throughout the country direct to central-station customers who are not furnished with free lamp-renewals and who cannot purchase tungsten lamps from the central stations at a lower price than from local dealers. The central station which is making active efforts to keep satisfied customers and give the best possible service for the money will probably in the future have to control the tungsten-lamp situation by the same methods that the carbon-lamp situation has been controlled in the past. This does not mean that absolute, free renewals of tungsten lamps need necessarily be given. The same purpose can usually be accomplished by selling lamps at so low a price that it is not worth while for local dealers to retail inferior lamps. In many cases it is not even necessary for the central station to do this, because the local dealers must recognize that at any time the central station, for its own protection, may inaugurate free renewals or the selling of lamps at cost, thus driving all local dealers out of the business. With such a possibility ever present and fully understood by the dealers, the central-station company usually has it easily within its power to insure a lamp of good quality and efficiency being sold in the smaller and medium-sized cities. In the very large cities such control is not feasible, and the only method is to sell lamps at a low enough price to keep the unscrupulous dealer out of the field. After all, the situation which has given rise to the present discussion of free lamp renewals is merely ephemeral, and principles adduced from it alone will be apt to prove ephemeral also.

The Carrying Capacity of Wires.

The carrying capacity of electric wires is a subject upon which much misapprehension exists. It is easy to define the carrying capacity of a wire as the strength of current which a wire can carry without being overheated. But when we attempt to define, with any degree of precision, what this strength of current is, we find ourselves involved in an embarrassing wealth of detail. Is the current carried continuously or is it intermittent? Is the wire covered with asbestos, or paper? Is it embedded in a porcelain tube or in sawdust? Is the wire out-of-doors, exposed to the wind, or is it indoors, and rubber covered? Is it in an underground conduit, or lead-covered and immersed in water? All such considerations bear upon the question of the safe carrying capacity of wires. A No. 10 copper wire will require, to raise its temperature 40 deg. C. above surrounding bodies, under normal temperature conditions, about 75 amp when suspended, bare, in calm weather out-of-doors; about 150 amp when rubber-and-braid covered, but immersed in running water; about 50 amp when suspended, bare, and horizontally in still air within doors, or when rubber-and-braid covered and supported in wooden molding. A temperature rise of 40 deg. C. would be a large rise to allow in house wires passing through inflammable materials and insulated by cotton braiding. It would, on the contrary, be a small rise to allow in bare wires or in asbestos-covered wires out-of-doors. All that can be done is to draw up tables of limiting current-strengths for wires of a specified kind of insulation, placed in a specified environment. Thus, the National Code allows 24 amp as the carrying capacity of a No. 10 copper wire, when rubber-covered, with reference to use indoors, but 32 amp when of the so-called "weatherproof" type.

The temperature-elevation of an active wire is as much a question of the strength of the cooling action as of the current strength, or heating action. It would be possible to find some unusual and unreasonable means of wrapping and enveloping a rubber-covered No. 10 wire which would make 24 amp a very hot current; and, on the other hand, by keeping the wire immersed in running water, 24 amp would be made a very cold current. Under ordinary practical conditions of house wiring, the rule gives a satisfactory safe limit, in view of the temperature at which rubber covering decomposes by thermolysis. A much stronger current could be carried without risk of melting the rubber. The rules of the National Code do not permit of the use of wires smaller than No. 14 (64 mils or 1.6 mm diameter), although this wire in rubber covering is assigned a safe current of 12 amp. Since a single incandescent lamp usually takes less than 1 amp, it would appear at first sight as though a smaller wire than No. 14 might be used with safety and economy. It must be remembered, however, that if a short-circuit occurs on the tap for one lamp, it may bring a small wire up to red heat before the cut-out blows, and that the rubber coating might, under particular conditions, become ignited thereby. The larger wire has a larger margin of safety in cold storage, or thermal capacity, against accidental short-circuits.

Moreover, there is always a danger of overloading a wire by carelessness. A tap is run to an outlet during the construction of an office building from the submains on a passage. The outlet is designed to supply a single innocent 16-cp incandescent lamp on a wall-bracket. The lamp takes less than half an ampere, and a No. 14 supply wire runs only a degree or two in temperature above its surroundings. Some day, the tenant in that office connects in a three-part plug-cluster, to which he harnesses a large and generous desk light, a comfortable fan-motor, and perhaps a commodious electric kettle, all fed at once through the No. 14 wire, which does not understand why it gets so hot. If the cut-out on that outlet is properly fused, no harm will be done, because the fuse will blow before the wire is dangerously heated; but if the tenant, discontented with the blowing of 5-amp fuses, forces in a 40-amp fuse, it would not be beyond possibilities for him to destroy the insulation on the wire. The plug-cluster itself is a beneficent convenience, but when ignorantly misused it may become a source of danger. It has been partly with an eye to such dangers that the National Code rule has been framed to the effect that a lamp circuit shall not take more than 660 watts from any one cut-out or outlet. This means 6 amp at 110 volts, or half the safe current of a No. 14 rubber-covered wire. It is clear that 6 amp is not in itself a dangerous current through an outlet or cut-out; but in connection with No. 14 wire taps, and absence of intelligent supervision, it is a wise limit.

Conference on Standard Electrical Rules.

The seventh annual meeting of the National Conference on Standard Electrical Rules was held on March 26 in the Engineering Societies Building, 29 West Thirty-ninth Street, New York City. To the list of companies and national bodies already represented in the Conference was added the name of the American Association of Electric Motor Manufacturers as an associate member. The Underwriters had been requested to appoint a sub-committee to revise Rule 12-A and inasmuch as the rule at present in force had been adopted in conference with other interests, the Underwriters desired an expression of opinion from the Conference, preferring that if this rule needed revision the suggestion to do so come from the National Conference on Standard Electrical Rules. The rule as at present in the Code is not lived up to by electric light companies and has no reference to the proximity of signaling wires, etc. The National Electric Light Association now has a committee working on standard specifications for pole lines, which committee expects to take two years to complete its work. It was suggested that the Conference appoint a committee to consider the matter of Rule 12-A, this committee to confer with a committee from the Underwriters and the N. E. L. A., and action to that effect was taken.

The Underwriters, feeling that if the Code were to be truly national in its scope, it should also contain rules which deal with the life hazard of electrical installations, stated they would have no objections to inserting such rules as the Conference suggested in the Code with a note underneath, each calling attention to the fact that inasmuch as they dealt chiefly with life hazard, the insurance inspector could not insist on their enforcement. A committee was appointed to report at the next meeting such rules as in the opinion of the Conference should be inserted in the Code. It was voted that in the revised edition of the Code, now being prepared for the printer, the Conference authorize the Underwriters to insert under the rules in Section 31-A (Theater Wiring), which dealt with life hazard, a note to the effect that compliance with the rule is recommended, but that the rule is not adopted for the purpose of lessening the fire hazard, so that no penalty could be enforced by the Underwriters for failure to observe its provisions. Mr. W. H. Blood, Jr., was re-elected president and Mr. C. J. H. Woodbury, secretary-treasurer of the Conference.

Revision of National Electrical Code.

At the seventeenth annual meeting of the Underwriters' National Electric Association, held in New York City on March 24 and 25, the various committee reports and suggestions for changes in the Code printed in the bulletin sent out by the secretary were considered and acted on. The changes do not go into effect until the revised Code is printed and distributed, which will be about July of this year. This edition will be a great improvement over previous ones and will be printed in two parts, one including the rules under classes A, B, C and E of the present Code and the other including classes D and F. All the fine-print notes will be limited to suggestions and explanations and are not to be considered mandatory; present fine-print notes, which are in effect rules, will be printed as such. Cross references will be eliminated when feasible, so that the rules will be complete in themselves as far as possible. The next public meeting of the electrical committee will not be held until 1911.

The committee appointed to consider changing the grounding rule, 13-A, recommends that the rule be not changed, and this recommendation prevailed. The committee was asked to make the rule mandatory up to and including 150 volts for alternating-current secondary circuits, and to prohibit grounding of such circuits carrying in excess of 150 volts. In the opinion of the committee, the fire hazard for one voltage was practically as great as for the other, and while the committee felt that the Underwriters should use all their moral influence in supporting a rule based on life hazard, they have no right to enforce a rule which cannot be defended on the ground that it is adopted for the purpose of lessening the fire hazard. Unfortunately the American Institute of Electrical Engineers failed to represent its views on the subject, though represented on the committee, and while the Association of Edison Illuminating Companies sent in a report favoring the grounding of the circuits while the meeting was in session, it came too late for action.

The report of the committee on circuit-breakers, covering specifications and rules, was adopted with some slight changes. Rule 21 was changed to read as follows: *Excepting on main switchboards or when subject to expert supervision, automatic, overload, circuit-breakers will not be accepted for the protection of alternating-current motors unless fuses are also provided in each phase. For single-phase motors, one side of the line may be protected by an approved automatic, overload, circuit-breaker and the other by a fuse.* This note applies up to the maximum capacity for which enclosed fuses are approved. For circuits above that capacity, circuit-breakers only will be required. Circuit-breakers must successfully operate three times with two-minute intervals intervening without incapacitating the mechanism, the condition of the testing circuit to be as given in the following table:

Ampere rating of breaker.	Per cent voltage drop in test circuit with rated current flowing.	Minimum available capacity of supply system not including overload capacity.
0-100	2	1000
101-300	3	3000
400	4	4000
500	5	5000

No filing of contacts or other repairing of the breaker is to be made during the test. Multiple breakers must comply with the above requirements whether the tests are made on all poles at once or on any pole.

The report of the committee on cabinets was somewhat modified so as to take in metal-molding systems. The cabinet must be deep enough to permit the closing of doors when switches of 25 amp rating or less are in any position. There must be a space of at least ½ in. between the walls and back of a cabinet and any live part. A space of at least 2 in. must be provided between open link fuses and metal, metal-lined or glass-paneled doors of cabinets. A space of at least 1 in. must be provided between the door of any cabinet and an enclosed fuse or any live metal part. The committee was continued to determine the best thickness of metal to be used in cabinets.

The laboratory report on flexible cord and cable was adopted with some few changes, and the whole matter was referred back to the laboratory for further consideration. The report of the committee on stage cable specifications was adopted, as was also that of the committee on switches and cut-outs with reference to the misuse of 125-volt Edison-type plug fuses on 250-volt circuits. The use of such fuses on 250-volt circuits is not approved.

The committee on Rule 64, signaling systems, suggested the following changes in the rule, which were adopted: The first eight words in section d were stricken out. A note to the effect that when the wires are carried in approved cables, sections c, d and e do not apply, was added to section e. The second and third paragraphs in section 1-3 were consolidated to read as follows: *Where the ground wire is attached to a water pipe or a gas pipe, it may be connected by means of an approved ground clamp fastened to a thoroughly clean portion of said pipe, or the pipe shall be thoroughly cleaned and tinned with rosin flux solder, and the ground wire shall then be wrapped tightly around the pipe and thoroughly soldered to it.* The last sentence in section n was changed to read as follows: *They must not come nearer than 3 in. to any electric light wire in the building, unless separated therefrom by some continuous and firmly fixed non-conductor creating a permanent separation; this non-conductor to be in addition to the regular insulation on the wire.*

The tentative report of the committee on auto-starters was adopted and the committee was continued with authority to include specifications for the construction of such devices in addition to the testing of the same.

Among the suggested changes to the rules which received favorable action were the following: Section d, rule 12, was stricken from the Code. Section b, rule 14, had the following addition made to it: *For wire smaller than No. 8 split knobs shall be used, and tie wires and knobs will not be approved.* The fine-print note to rule 40, section b, was amended by striking out reference to rules 43 and 42. Rule 49-A, section i, was amended by the addition of the following words: *Covers may also be made of porcelain or other approved material, provided they are of such form and thickness as to afford suitable protection and strength.* Section c, rule 54-A, now reads, *line terminal plates must be at least 0.06 in. thick. Rule 55, section j, was amended so that all insulating material inside of a socket must be of porcelain or other approved material.* A new section was added to rule 57 to the effect that terminals must be designed to secure a thoroughly good and permanent contact with the supply wires, which contact must not become loosened by motion of the lamp during trimming. Rule 60, section f, was amended to read as follows: *Motor starting rheostats for direct-current circuits must be so designed that the contact arm cannot be left on intermediate segments and must be provided with an automatic device which will interrupt the supply circuit before the speed of the motor falls to less than one-third of its normal value. For alternating-current circuits the automatic interrupting device may be omitted.* The ideas of many suggested changes were adopted and the rules referred to a committee for rewording. Committees were appointed on wiring and installation of high-tension motors, on fixtures and fixture wiring and on the question of changing the relative positions of the meter, cut-out and service switch so as to prevent the theft of electricity. Rule 12-A, on constant-potential pole lines, was referred to the National Conference.

Annual Report of the American Telephone & Telegraph Company.

The annual report of the American Telephone & Telegraph Company, which is dated March 16, is exceptionally interesting. In addition to the usual statistics and account of operations, it contains a general statement as to the relations of the American Telephone & Telegraph Company with associated companies, which relations are said not to be generally understood. A reply is made to criticisms of Independents, and a statement is given as to the relative money value of the parts of a telephone system.

As to the relations with the associated companies, it is stated that the parent company is primarily a holding company, holding stocks of the associated operating and manufacturing companies. As an operating company, also, it owns and operates the long-distance lines which connect all the systems of the associated operating companies. In addition, it assumes centralized general administrative functions with relation to all the associated companies, which are thus assisted and directed in the development and introduction of new ideas, methods and inventions. It has a department, organized at the very beginning of the industry, where a record is kept of practically everything known about inventions pertaining to the telephone or kindred subjects, and where every new idea is examined, and its value, so far as patent features are concerned, determined.

The engineering department takes up all new ideas, suggestions and inventions, and passes upon, studies and develops them. It has under continuous observation the study of traffic methods and troubles, with a view to improving or remedying the same. It studies all construction, present and future development or extension schemes, makes plans and specifications for the same, and gives, when desired, general supervision and advice. The department has a corps of experts which, in addition to the above work, is at all times at the service of any one or all of the separate companies. A large staff has been and is continuously engaged in the consideration of disturbances arising from transmission and other lines carrying heavy currents, and that any telephone system in many cases can even exist in the vicinity of such lines is due to the constant attention given to this subject. Every new trouble comes before this department, and when settled there it is settled for all. This has resulted in a standard commercial, operating and plant practice not only for all associated companies, but for other companies of high standing throughout the world. All devices and inventions submitted receive a thorough and painstaking investigation, and it is believed that there has as yet been no instance where any invention, system or method rejected by the patent and engineering departments of the company, has ever had any permanent success when used elsewhere.

The manufacturing department creates and builds all the apparatus which has been adopted, with the result that throughout the whole system are found standardization and uniformity. None of the companies alone could maintain such an organization, and it would be fatal to any service to introduce or try out undeveloped ideas in actual service. The legal department forms a clearing house in all legal matters for all legal departments of the separate companies, to which assistance and advice are given on all questions of general scope. The centralized general administration, in short, takes care of all those matters which are common to all companies, or which, if taken up by each company, would mean multiplication of work, effort and expense, without corresponding advantage or efficiency.

Referring to the criticism of Independents, it is stated that, in view of the preponderating Bell interests in the telephone business of the country, it is due to the parent and the associated companies at least to call attention to the misleading statements, to promises in prospectuses impossible of fulfillment, and to advertisements offering to the public securities at large discount, promising large prospective dividends, issued to build exchanges in which service is to be given at impossible rates. In all controversies as to rates, franchises and so on, in all hearings before public bodies, Bell representatives have been confronted with such promises, statements as to what interests other than the Bell were doing, and with assertions that if it were not for watered stock rates could be reduced, or the business conducted at a profit on much more favorable terms to the public. "All that experience has taught was as nothing to the promises of franchise vendors and manufacturers' agents. Established business and property were put in jeopardy, with the result that there are many instances where the public has on its hands a partially duplicate exchange with partially duplicate subscription costs, and no one has benefited except the promoters of the schemes." It is said that there is now a decided tendency on the part of the public to favor consolidation wherever there are two exchanges in the same community.

Studies have been made during the year to determine the actual rate of depreciation which should be provided for. Of the total value of the telephone plants owned by the American Telephone & Telegraph Company and associated companies, real estate constitutes 9 per cent; underground conduits and cables, 20 per cent; copper wires and aerial cables on poles, 18 per cent; pole lines, not including wires but including the ownership of rights of way over private property, 26 per cent; iron wires, 4 per cent, and central office and substation equipment, 23 per cent. As to the depreciation, real estate is standard and established. Underground conduits can be classed with real estate, or rather with permanent construction on long-term ground rents. Cables and copper wires have shown very little depreciation, but experience has not yet established a definite rate; there is, however, a net scrap value of 40 per cent. Iron wires have a life of from 8 to 15 years. Pole lines have a life of from 10 to 16 years. Central and substation equipment has a depreciation dependent on its character, the condition in which it is maintained and the policy of renewal or replacement by new or improved apparatus.

Of the total mileage of exchange wires over 50 per cent is underground. Of the total value of exchange wires 84 per cent is copper and 16 per cent iron. Of toll wires 91 per cent is copper and only 9 per cent iron. There are now underground conduits and cables between New York and Philadelphia, Chica-

go and Milwaukee and a substantial part of the way between New York and Boston. Some pole lines of the company are for a considerable length built over rights of way actually owned by the company, acquired at a cost of some $8,000,000; it is stated that these rights could not now be acquired at many times that outlay, if at all. A valuation of the exchange, toll and long-distance line plant included in the Bell system in the United States was made in 1907, based upon the replacement cost of the existing plant. This appraisement gave the plants a value of $35,000,000 in excess of the obligations outstanding against them. Several valuations of all or parts of the plants of several of the associated companies have been made either by or under the direction of public authorities, and it is stated that in every case the valuation so made exceeded the valuation as carried on the books.

The entire Bell system, including Canada, showed earnings for 1908 of $140,016,400, an increase of $7,009,500 over 1907. The total expenses were $94,042,400, an increase of $3,101,100 over 1907. The balance of net earnings was $45,974,000, an increase of $3,908,400, and the undivided profits were $13,601,400, an increase of $904,000 over 1907. The total combined assets Dec. 31, 1908, were $680,044,200, which included $54,916,000 cash and cash assets. The surplus for the same period was $31,759,600. Plant depreciation reserves were $20,728,500, and general depreciation reserves $19,751,800.

The number of stations of the Bell system in the United States operated directly by the associated companies at the end of the year was 3,215,245, an increase of 179,712. In addition, there were 1,103,144 exchange and toll stations connected to the system by its toll and long-distance lines, but operated by local, co-operative and rural Independent companies and associations having sub-license or connection contracts. Adding also the telephones employed for private line purposes, there was a total of 4,364,629 stations connected to the Bell system, as against 3,839,000 stations at the close of the previous year, an increase of 525,629 stations; 1,220,126 miles of exchange and toll service were added during the year, bringing the total to 9,830,718 miles. Including the traffic over the long-distance lines, but not including sub-licenses, the daily average of toll connections was about 463,000, and of exchange connections about 18,500,000, a decrease in the former of 31,000, and an increase in the latter of 370,000.

The total plant additions during the year amounted to $26,637,200, not including a large amount of real estate purchased from the American Telephone & Telegraph Company during the year. This is a very considerable reduction from the additions during the years 1900-7, those in 1906 amounting to $79,366,900, and in the year 1907, $52,921,400. During the year $39,736,700 was applied out of the revenue to maintenance and reconstruction purposes. The associated operating companies during the year decreased their obligations to other than the American Telephone & Telegraph Company by $2,709,000, while the cash on hand increased at the same time $2,295,000.

The gross earnings in 1908 of the Bell telephone companies of the United States, the American Telephone & Telegraph Company not included, were $127,117,200, an increase of $6,364,000 as over the preceding year. The total expenses were $91,461,600, an increase over the previous year of $3,553,600. The balance of net earnings were $35,655,600, an increase of $2,810,400, and the undivided profits were $7,076,600, an increase of $463,000. The total assets were $566,540,900, an increase of $25,178,600. During the year the surplus decreased by $633,700, and depreciation reserves increased by $5,161,400.

A New Chicago Telegraph Company.

The People's Mutual Telegraph Company, of Chicago, referred to in the issue of March 18, was granted an ordinance to use the streets of Chicago at a meeting of the City Council on March 22. This company, although expecting to do much Board of Trade business, will also enter the field of general telegraph business in the territory it serves, being, indeed, compelled to do so by the terms of its Chicago franchise. The principal office, at least at first, will be in the Chicago Board of Trade. From there its wires will lead, through existing conduits, to the Van Buren Street tunnel under the South Branch of the Chicago River, thence to the Metropolitan Elevated Railway structure and so to the western city boundary. New overhead construction will be needed from this point to Joliet, Ill., where a connection will be made with leased wires (probably belonging to Independent telephone companies) going to St. Louis and Kansas City and possibly Omaha, with entrance into the cities named. Reduced rates (day service) will be offered—25 cents for 10 words and 2 cents for each additional word, Chicago-St. Louis, with 30 and 2 cents as the Chicago-Kansas City rate. The People's Mutual Telegraph Company is an Illinois corporation, in which Chicago Board of Trade brokers, dissatisfied with existing telegraph rates, are interested. Its officers are as follows: President, Mr. Arnold Kalman, Chicago; vice-president, Mr. H. C. Stifel, St. Louis; secretary and treasurer, Mr. H. L. Stern, Chicago. Mr. W. C. Polk, of Toledo, Ohio, has done the preliminary engineering work. The Chicago & Milwaukee Telegraph Company, a distinct corporation, but also backed by Board of Trade interests, has operated a telegraph line between Chicago and Milwaukee successfully for several years.

Iowa Electrical Convention Program.

The Iowa Electrical Association will hold its annual convention for 1909 at Cedar Rapids, Iowa, April 21 and 22. Headquarters are at the Hotel Montrose. An arrangement similar to that in force last year, whereby the association provides free-of-charge space for exhibits, has been made for this year. There will be a large exhibition hall, and electrical energy required by exhibitors will also be supplied free. This hall will probaby serve both for the exhibits and meeting-place, so that not only will the exhibits be sure to receive attention from the central-station man, but the prompt calling of the meetings will not be handicapped by detention of central-station men at parlor exhibits. The plan is one which has given excellent satisfaction both to exhibitors and central-station visitors. A letter recently received from Mr. L. D. Mathes, of Dubuque, president of the Iowa Electrical Association, is so much to the point regarding the work and aims of this association that we quote from it:

"Our association has gained much in strength and is steadily improving in strength and interest. Our object is to keep close to the ground; down within reach of the men who actually handle the plants of this State. We never attempt highly technical discussions, feeling that theoretical issues can be dealt with by the individual companies through the engagement of specialists as such questions arise. Our endeavor is to analyze thoroughly the every-day problems; to talk right out in meeting, as it were, about our experiences from every angle of the operating standpoint."

Reservations for exhibit space can be made through Mr. W. N. Keiser, of Des Moines, secretary of the association. The following papers will be presented:

"Portable Vacuum Cleaners," by Mr. O. E. Brownell, Lake City; "Application of Electricity in the Conduct of the Modern Home," by Mrs. L. D. Mathes, Dubuque; "The Effect of the Introduction of the Tungsten Lamp on Central-Station Revenues," by Mr. Thomas Ferris, Osage; "Ornamental Curb-Line Illumination," by Mr. D. F. Fradette, Des Moines; "Amount of Daylight Business Sufficient to Justify 24-Hour Service, and Methods Adopted to Increase the Daylight Load," by Mr. M. A. Harrison, Nevada; "Aid of Prismatic Reflector to the High-Efficiency Unit," by Mr. Morgan P. Ellis, New York. Discussion: "On the Progress of the Introduction of Heating Units by Central-Station Companies," by representatives of the trade; "The Story of a Successful Sign Campaign, with Facts and Figures," by Mr. J. B. Lindl, Dubuque; "Selling Electrical Domestic Appliances in a Small Town," by Mr. W. W. Sterns, Humboldt; "Importance of Close Inspection of Customer's Installations," Mr. W. B. Greene, Cedar Rapids; "Does It Pay the Central Station to be Broad-Gaged in Dealing with Its Customers?" by the president.

New York Public Service Commission News.

Information was lodged with the Public Service Commission of the First District of New York last week that the Interborough Rapid Transit Company had secretly constructed an inclined tunnel between its line at Grand Central Station and the western end of the Steinway tunnel in Forty-second Street near Lexington Avenue. At a meeting of the commission, March 29, Henry B. Seaman, chief engineer of the commission, testified that he found that an inclined tunnel had been cut between the two tubes, varying in inclination from 18 to 45 deg., and in size from 6 ft. to 10 ft. in diameter. He said that the tunnel passed through the location asked for by the Hudson & Manhattan Railroad as a station site, and would interfere with its construction at that point. Mr. Frank Hedley, general manager of the Interborough, admitted to the commission that he had given the order for the construction of the tube some time last summer, but that he had asked no permit, as he believed it was covered by the franchise of the Steinway tunnel. Mr. Hedley said the connection was simply for carrying cables. Mr. Seaman also reported that the Steinway tunnel had gone beyond its franchise in constructing a loop under Park Avenue.

Mr. Theodore P. Shonts, president of the Interborough, has insisted to the commission that if the McAdoo permit was granted it be for the use of the third level below the present subway. Mr. McAdoo claims that to put his road so far under the ground would render it practically useless, and intimates that this is the purpose of the Interborough's president. Mr. Shonts has also sent a communication to the commission protesting against the construction of the Lexington Avenue Subway as proposed by the Bradley-Gaffney-Steers syndicate. He claims that the actual return on the capital invested in the present Subway is less than 6 per cent and that a new subway could not be constructed at a smaller cost and would not accommodate a greater volume of traffic.

A committee of the Woman's Municipal League of New York has petitioned the Public Service Commission to order that one car be set apart in every subway train for the exclusive use of women. The petition explicitly states that this designation of a separate car shall in no wise interfere with the rights of women to use the other cars of the train. The commission has instructed the Interborough to show cause within 10 days why such an order should not be made.

Receiver F. W. Whitridge, of the Third Avenue Railroad, has been given permission to construct the extension of his line around the crest of the hill at Fort George. The commission sharply criticized Mr. Whitridge for having gone ahead with the construction before the permission was given.

The Public Service Commission of the Second District of New York has extended to July 1 the time within which the Tarrytown, White Plains & Mamaroneck Railway Company shall vestibule its cars. This was done because the road had ordered cars which could not be delivered before that date.

The Public Service Commission of the Second District of New York has granted the Delaware & Otsego Light & Power Company permission to construct and operate an extension of its electric line from East Sidney to Sidney Center and also to issue $15,000 of common stock. The proceeds of this stock issue are to be used in the acquisition of property and the improvements of plant. The commission has also approved the lease by which the Buffalo & Lackawanna Traction Company leases its property and franchises to the Buffalo & Lake Erie Traction Company for 999 years.

Justice Fitts, of the Supreme Court, at Albany, N. Y., has handed down a decision in which he holds that the Public Service Commission law is constitutional and that the Economic Power & Construction Company, of Buffalo, is under the jurisdiction of the commission and must make reports to it. The company, which possesses a blanket charter obtained from the Legislature a number of years ago authorizing it to sell electrical energy for light and power in any part of the State, refused to report to the commission or to produce its books for inspection. The company held that under its charter it was outside the pale of the public service law. Under the present decision the company is liable to a penalty of $100 per day, since its refusal to report, or a total of $23,500. The company will appeal from the decision.

New Jersey Public Utilities Legislation.

The New Jersey House of Representatives last week passed a public utilities bill introduced by Mr. W. P. Martin, of Newark, modeled after New York legislation on the subject. Later the vote was reconsidered and the bill laid on the table. Another public utility bill now before the Legislature, known as the Pierce bill and which is much less sweeping than the Martin bill, passed the Senate last year. The Martin bill provides for a commission of five members, gives power to fix rates, to examine the books of public utility companies and to value their property. In view of the differences of opinion that have developed as to the details of such a measure, there appears to be little likelihood of the passage of any public utility bill at the present session of the Legislature.

Conservation of Natural Resources.

On March 24 the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers held a joint meeting in the Engineering Societies Building, New York, to consider the subject "Conservation of Natural Resources."

Mr. John R. Freeman called attention to the fact that deforestation has not appreciably affected the flow of important streams, such as the Hudson, numerous lecturers to the contrary notwithstanding. Wooded land does act as a retaining reservoir with better results than does cleared land, but the percentage of wooded land to the whole area has not been decreased appreciably by deforestation. Moreover, young trees are approximately as effective in retaining water as are old trees. Greater damage is done by forest fires than by lumbermen. However, lumbermen should be compelled to take steps to prevent the starting of forest fires among the wood left drying on the ground by them. Mr. Freeman stated that the advantages to be derived from hydro-electric developments are frequently overestimated.

Dr. Rossiter W. Raymond presented a paper discussing conservation by legislation in which the dangers of legislative conservation were outlined. He expressed the opinion that the engineers should educate the public by presenting facts and not opinions for the consideration of those whose actions may affect future legislation.

Mr. Charles Whiting Baker said that the losses by fire during 1907 amounted to $215,000,000, one-half being for buildings and the other for contents. To show the extent of the fires, Mr. Baker remarked that if the buildings destroyed were placed on the two sides of a street, each house occupying a frontage of 60 ft., the street would reach from New York to Chicago.

Mr. Lewis B. Stillwell dealt with the economics of conversation as affected by hydro-electric developments. He showed that the energy now utilized at Niagara represents an actual saving of from one to two million tons of coal per year. The advisability of placing a tax upon hydro-electric developments is greatly to be doubted; they should be encouraged. Before the proposal to tax water-powers in order to assist inland waterways, information should be obtained concerning the relative costs of haulage by canal and railroads. It should be remembered that each horse-power obtained from water when utilized for 10 hours per day saves at least 7.5 tons of coal per year. A very large saving can be secured by substituting electric motors receiving energy from large central plants for the numerous steam engines in cities obtaining energy from small uneconomical boilers.

Report on Transportation Subways in Chicago.

As announced in these columns last week, a very elaborate report has been made public by the committee on local transportation of the City Council of Chicago on the question of underground transportation in that city. The report was prepared by the Bureau of Engineering of the Department of Public Works under the direction of Mr. John Ericson, chief engineer, and Mr. Thomas T. Johnston—who died about a month ago—chief assistant engineer. It comprises three leather-bound volumes, 25 in. wide and 15 in. high, each containing about 70 pages. In addition there is a supplementary pamphlet of 151 pages, describing the Boston, New York and Philadelphia subways, the Metropolitan Underground Railway of Paris and the various underground roads in London. In the report need be constructed to care for present necessities and extensions can be built from time to time as the population and transportation situation becomes clarified and settled.

It is the intention to include space within the subway structure for the accommodation of sub-surface utilities, in order that the utmost capacity of the street for all purposes will be made available. The plan calls for a "utilities gallery" having a flexibility that will allow of its apportionment as future demands may require.

Considering "Procedure in Construction" the report has this to say: "While the studies of this subject have not progressed to a conclusion, it seems likely that a four-track subway north and south at the eastern side of the business district and extending from the vicinity of Chicago Avenue and Orleans Street to the vicinity of State and Twenty-second Streets, will

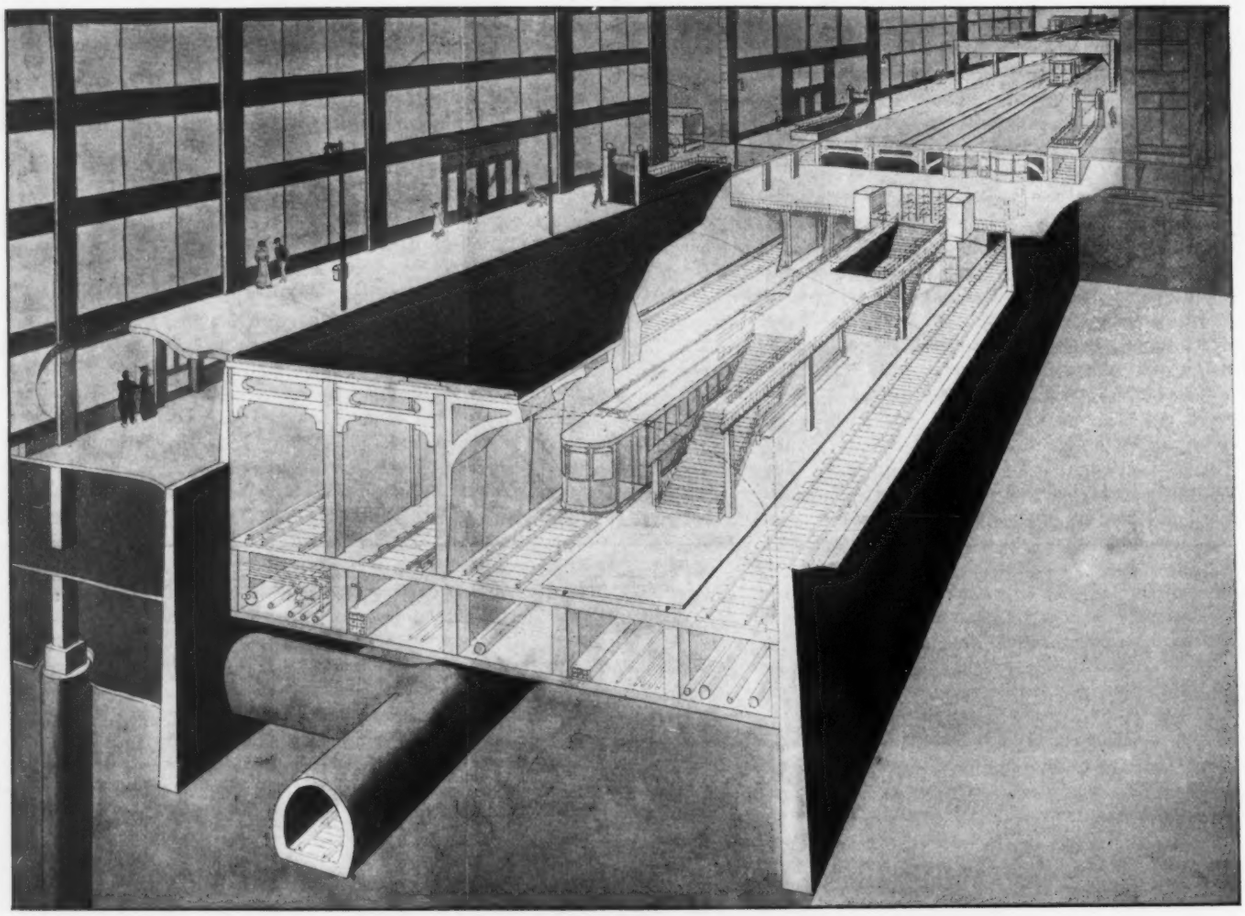


FIG. 1.—ISOMETRIC VIEW OF PROPOSED SUBWAY IN CHICAGO.

proper there are 79 folded plates, each 23 in. wide and 30 in. high. Many of the plates are colored. An index is furnished with each volume.

The first volume is devoted to "General Elements" of the study of the subway situation in Chicago; the second to "Public Service Utilities," and the third to "Water Supply Analysis." It is to be understood that the report is merely preliminary, for the purpose of assisting the local transportation committee in the public discussion of the question. Only a portion of the data collected by the Bureau of Engineering is included in it. The area considered in this report for the ultimate construction of transportation subways is bounded by Chicago Avenue on the north, Lake Michigan on the east, Twelfth Street on the south and Halsted Street on the west, embracing what is known as the downtown business district.

At the beginning is an "Analysis" of the whole situation, in which it is stated that in the first instance only such subways be desirable, and that contemporaneously or following this first undertaking two east-and-west subways may be made, one reaching a terminal in the vicinity of Halsted Street and Blue Island Avenue and the other reaching a terminal in the vicinity of Lake and Halsted Streets. These West Side terminals will provide for collecting traffic of the Metropolitan Elevated Railroad and the Lake Street Elevated Railroad and also of a number of surface lines now converging close to these points.

"The essence of the arrangement is the location of subway terminals, four in number, on each of the four elevated railway lines at the margin of the business district, and which are also located at points of close convergence of a large number of surface lines. A large provision for future traffic requirements will thus be brought about, and as a necessary consequence the carrying capacity of the existing transportation lines or their equivalent outside of the business district will be accomplished."

A trial design has been worked out for a four-track subway from Chicago Avenue and Orleans Street at the north, through Wabash Avenue, in the central business district, to State and Twenty-second Streets on the south—a distance of a little over three miles. The capacity of such a subway would be 18,000 passengers an hour in each direction for surface cars and 25,000 passengers an hour in each direction for elevated cars, two tracks being devoted to each class of traffic. This plan contemplates the movement of 240 cars an hour on the tracks devoted to surface lines and 50 trains, each of seven cars an hour, on the tracks devoted to elevated lines. The total carrying capacity of this one subway is thus 86,000 passengers an hour, thus adding 50 per cent to the carrying capacity of the local transportation lines.

The design contemplates eight capacious entrances at each subway station. A feature will be a sub-surface foot passageway to enable pedestrians to cross the street free of danger from street traffic. Space for news stands and telephone booths has been provided. A large utility gallery has been provided below the train platforms, in which the several utilities can be of five compartments each about 11 ft. wide and from 6 ft. to 8 ft. high in the clear, located so as to receive sewer, water, gas, telephone, telegraph, electric and other public-service conduits.

Reinforced-concrete construction is recommended. The stresses due to fixed and moving loads are carefully figured out. The roof of the subway, forming the surface of the street, is to be 2½ ft. thick.

. The general plan of construction is to maintain a rectangular section, utilizing all the space available between the curb walls, the street surface and the general level of the construction of the Illinois Tunnel Company. The floor in the utilities compartments may rest directly on the earth. Besides the sidewalls of the subway, four rows of columns are provided. Upon these will rest massive concrete girders, extending from wall to wall. These girders will serve to support track stringers and train platforms.

During construction sub-sidewalk areas may be used temporarily for public-utility lines, or overhead construction may be permitted temporarily.

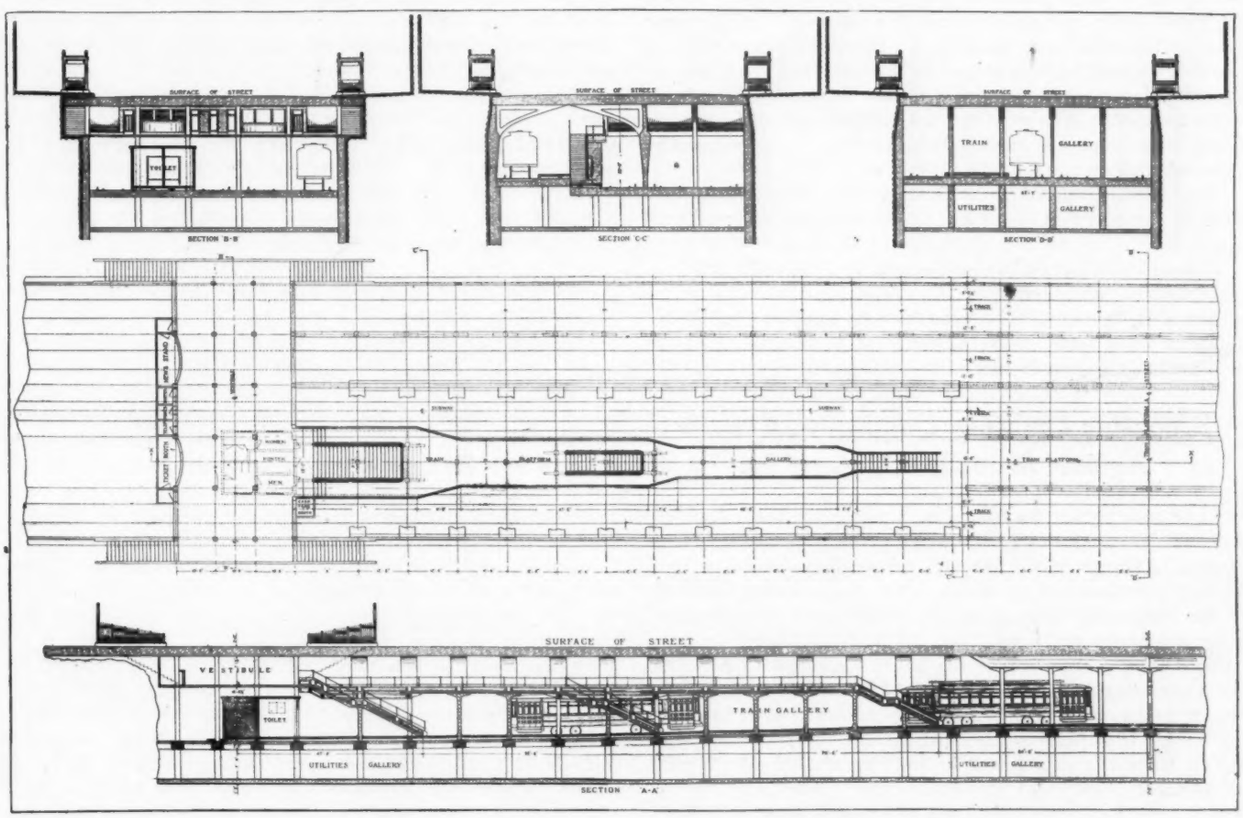


FIG. 2.—SECTIONS, PLAN AND ELEVATION OF CHICAGO SUBWAY STATION.

arranged. At street intersections and at each side of the subway utility have been provided chambers extending from the bottom of the subway to the surface of the ground, in which the utilities passing through the subway may be connected to those in the streets crossing subway lines.

Elaborate studies are made of the growth of population by areas, water supply data, traffic statistics and data and location of surface, elevated and suburban steam railways with reference to population.

The features of the proposed four-track subway are enumerated in the following paragraphs:

Island train platforms are provided, located alternately between the two tracks for the use of the elevated lines and also the two tracks for the surface lines.

The train platforms are 16 ft. wide and longer than necessary to accommodate two trains of nine cars—one train on each side.

The "utilities gallery" beneath the space for cars consists

The general idea has been to place water and gas pipes in the bays nearest the curb line, electrical conduits in the next bay, with the center bay kept clear, as far as possible, for convenience in handling material for repairs, changes, etc.

It is estimated that the cost of making the subways, excepting such costs as will pertain to foundations of buildings, will be as follows:

	Cost per mile.
Four-track subways, as in Wabash Avenue	$3,750,000
Three-track subways, as in Washington Street	3,375,000
Two-track subways, as in Van Buren Street	3,000,000
One-track tunnels, as under the river	800,000

DATA ON PUBLIC UTILITIES.

Volumes II and III, embracing a large amount of data on the subject of various existing or proposed public utilities in the streets, were really prepared first, before the scope of the investigation was enlarged to embrace the location and preliminary designing of the subways. Among other subjects

treated in Vol. II are the underground constructions of the Commonwealth Edison Company. This utility will require more space than any other if its business should expand in proportion to the requirements of the changed character of buildings now replacing the other structures in the business district. A number of distribution diagrams are given, and various typical underground conductors used in the Edison system are illustrated.

In relation to city electrical utilities, data are given of street-lighting, fire-alarm telegraphs and the police telephone system. Data are also given relating to the use of the streets by the Chicago Telephone Company, by the gas company, by the telegraph companies and also relating to sub-sidewalk occupancy. One section relates to the miscellaneous occupancy of streets and alleys as by various steam pipes, chutes, vaults, tunnels, etc.

A survey is made of the elaborate system of comparatively deep tunnels belonging to the Illinois Tunnel Company and underlying the streets in the business district. This network, sometimes referred to as "Underground Chicago," embraces 65 miles of tunnels. In these tunnels merchandise, coal and freight are transported on narrow-gage electric railways, pulled by 250-volt, direct-current electric locomotives. The company is not allowed to carry passengers, and the highest portion of the tunnels must be at least 19 ft. below city datum. The main business at present is to transfer freight from one railroad terminal to another. This utility need not be disturbed by subway construction except at river crossings where the tunnel can be diverted without affecting its usefulness.

Other data given relate to bridges and viaducts and their foundations, and also to the occupancy of property for railroad use.

Volume III is devoted to water supply analysis and a study of high-pressure water systems. It is estimated that the water supply with the high-pressure system will require at least three times as much space in the future as at present, while sewers will probably require 50 per cent more space.

Brookline Lighting Committee Reports Against Municipal Ownership.

After an investigation lasting over two years, and in accordance with the advice of Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, the municipal lighting committee of the town of Brookline, Mass., has reported adversely on the proposition to consider the establishment of a municipal lighting plant in the town. This report is of more than ordinary interest on account of the position of Brookline among American municipalities. The town is the wealthiest community under the old-fashioned form of town government in the world; it is perhaps the most famous of the Boston residential suburbs, and is unique in its location within the borders of adjacent portions of the city proper. Practically, Brookline is a residential section in the midst of Boston; politically, it is a separate community. From the standpoint of wealth, therefore, the town is in a position to buy and operate any equipment for economical energy production on the market, and the unanimous report of the committee against municipal electric lighting is therefore of special significance.

In taking up the question of a municipal plant the committee found it necessary to determine what would be a fair rate for the existing company—Boston Consolidated Gas Company, Electrical Department—to charge in the town. It was soon found that no progress could be made by comparing the rates paid in Brookline with those charged in other localities on account of different conditions of production and distribution. There is iittle manufacturing in the town and many of the residents leave during the summer, entirely cutting off their consumption of energy. A detailed inventory was, therefore, made by Professor Jackson of all the company's electric equipment within the town borders. Assuming the rate at which energy could be delivered at the town line to be 3.5 cents per kw-hour, a study was made to determine the reasonableness of the existing rates, 8 per cent being taken as a reasonable return upon the company's investment.

The valuation of the property aggregated $320,250 on the basis of reproducing it new. The energy sold in Brookline during the year ending June 30, 1908, was about 1,422,000 kw-hours. The estimated energy generated was 1,777,500 kw-hours. The maximum demand was about 760 kw. The population of Brookline is about 24,000.

Professor Jackson reported that a contract rate of 14 cents per kw-hour would appear to be reasonable for electric incandescent lighting, or by maximum demand, 16 cents primary, 7.5 cents secondary and 5 cents tertiary charge per kw-hour; and for arc lamps on the streets $110 per annum per all-night lamp of the character in service. The rates charged to the consumers in Brookline for the year ending June 30, 1906, included a flat rate on contract of 18 cents per kw-hour, and maximum-demand primary, secondary and tertiary rates, respectively, of 20 cents, 8 cents and 5 cents per kw-hour for incandescent lighting; 13 cents per kw-hour with various discounts for energy used by motors, and $124.10 per arc lamp on the streets per all-night service throughout the year. The incandescent lighting rates were decreased Jan. 1, 1908, by reducing the maximum-demand primary rate from 20 to 18 cents and reducing the flat rate from 18 to 16 cents. The estimates of Professor Jackson showed that the company would be still earning 8 per cent on its investment over and above all expenses and depreciation reserve, had all the rates been reduced by 20 per cent instead of by the amounts outlined above.

The service in Brookline comprises commercial electric lighting, commercial electric energy supplied to motors, and arc lighting for the streets. The first of these items demands over 80 per cent of the total peak load, and it is the most expensive service to render, when measured in the cost per kw-hour. The second, or motor, item demands not much over 2 per cent of the total maximum load, and the remainder of the maximum load is comprised in the arc-lighting service. The arc lamps are operated many more hours per year than the incandescent lighting load that goes to make the major portion of the peak load, and the arc-lamp load is therefore much more desirable for a plant than is the Brookline incandescent load.

The report states that in case the town should go into the municipal lighting business it might buy energy at wholesale rates from either the gas company or the Boston Edison Company, or it might build a generating plant of its own. To meet the requirements of the present load in Brookline, with a reserve of one-third equipment above ordinary maximum load requirements, a plant built by the town would necessitate a generating rating of not less than 1000 kw, which would be put in three independent generating units and auxiliary appliances, housed in a suitable building. The cost of such a plant and building would be about $148,000. Assuming that the land could be obtained for $12,000 makes the aggregate generating-plant investment $160,000, which would have to be added to the investment of $320,000 put into the distributing plant and business. This would make a total investment of $480,000 for the town for the complete electric plant and business in operating condition. If such a plant were operated with intelligent economy the cost of generating and delivering energy to the terminals of the station would amount to not over 3⅜ cents per kw-hour when 8 per cent is allowed for interest on the investment for the generating plant and a proper depreciation reserve is provided.

The private customers who are now supplied with electrical energy by the Boston Consolidated Gas Company do not provide an ideal load for such a plant because a great part of their use of energy is of only short duration each day and a high peak load occurs during the Christmas holidays. This fact makes it necessary to provide a relatively large amount of machinery with a correspondingly large investment for the purpose of taking care of an output of a relatively small number of kw-hours with the result that interest and depreciation which come into the cost of generation are relatively large per kw-hour, and the expense per kw-hour at the terminals is

greater than would be the case in the instance of a generating station serving more diversified population.

The town of Brookline could probably buy wholesale energy now from the Boston Edison Company at a price as low as 2⅛ cents per kw-hour, which, with an allowance for substation attendance, would make the average cost per kw-hour delivered at the secondary busbars of the substation not far from 2.5 cents. This fact makes it undesirable for the town to build its own generating plant. The town simply could not compete with such a price when generating energy solely for the load provided by itself and its citizens.

The gas company has agreed to reduce its rates from 16 cents per kw-hour flat rate for electric lighting to 14 cents on July 1, 1909, and to again reduce this rate to 13 cents on July 1, 1910. It also agreed to reduce on July 1, 1909, its maximum-demand rates by the following amounts: Primary rate, 18 cents to 16 cents per kw-hour; secondary rate, 8 cents to 7.5 cents per kw-hour. The arc-lamp charge will be reduced to $110 per year. The saving to the town arising from the last agreed concessions in rates would amount to $14.10 per year for each arc lamp, of which there are now over 260, and it would also mean a reduction of nearly 28 per cent from the flat rate in force before 1908. Professor Jackson states that this concession is sufficiently large to make it a questionable project for the town to enter upon electric lighting for itself. The difficulties in the situation are increased by the fact that the gas company might refuse to sell its electrical distributing plant to the town without the town taking over the company's gas distributing plant, and the town might, therefore, be forced to go into the manufacture and distribution of illuminating gas. The town could gain no advantage at the present time by going into the gas business.

During the period of negotiation between the committee and the gas company, the Boston Edison Company appeared in the situation as a purchaser of the gas company's electrical plant. It is understood that the regular Edison retail rates will go into effect in the town when this arrangement is completed.

The approval of the purchase of the electrical business of the gas company by the Massachusetts Gas and Electric Light Commission, if granted, will open the way toward the best solution of the whole question of rates in the town of Brookline, and the building of a municipal plant or the entering of the town into the business of electrical distribution will accordingly not be necessary for the most efficient results.

Electric Railways and Publicity in Massachusetts.

Publicity is playing a most important part at the present time in Massachusetts in awakening the public to an accurate appreciation of the electric railway situation. In engineering and transportation circles it is well known that electric traction is face to face with two most difficult problems at this time; the problem of securing a square deal at the hands of the people, and the problem of earning enough money to pay a fair return upon the investment. The first dilemma is shared by electric railways in common with all kinds of public service corporations, while the second difficulty bears perhaps a little more heavily at this period upon the electric traction industry than upon any other quasi-public undertaking. These facts have been made plain to workers in the railway field by able discussions of conditions in the technical press and before electric traction organizations; they have been brought home to operating officers of even the largest urban systems through executive orders to administer departments with maximum economy, and they have been keenly appreciated by the manufacturers and supply men who have striven for many months to overcome the handicap of a reduced demand for their products from the consuming railways. The feeling is now general that it is time to place the facts of the situation plainly and clearly before the public, which is disposed to act fairly and sanely when conditions are once thoroughly understood. Three movements in this direction during the past week in Boston are worthy of attention as indicating the possibilities of practical publicity in improving the whole tone of the electric railway business in the State of Massachusetts.

At the meeting of the New England Street Railway Club, on Feb. 25, Mr. Frank Hedley, vice-president and general manager of the Interborough Rapid Transit Company, New York, devoted a portion of an address to the plain statement that unless the public can be acquainted with the real inwardness of the electric traction situation with respect to very limited returns and the injurious effects of ill-advised legislation, it will ere long be practically impossible to enlist capital for needed improvements, to the great detriment of the whole community. He showed that the field of the electric railway is far from fully developed as yet; pointed out that additional facilities are essential for the best good of all citizens, and finally emphasized the need of both the public and the companies doing business fairly and squarely, without capital inflation or ignorant efforts to alleviate difficulties by destructive legislation.

Mr. C. S. Sergeant, vice-president of the Boston Elevated Railway Company, then showed how the successive improvements in methods on New England's largest system have demanded money, which has to a great extent come out of earnings; that through the increasing demand of the public for additional facilities and the enormous extension of the use of free transfers, combined with a constantly increasing cost of operation due to advances in the price of labor and materials, the purchasing power of the nickel from the railway standpoint has dropped from 5 cents to 3.15 cents. Mr. Sergeant stated that he believes that the public wants service, and that a broad campaign of publicity is absolutely essential for the proper spreading of the facts, not only in Massachusetts, but throughout the electrical world. No employee is too humble to do his share in bringing out the facts, and all over the country manufacturers can help by educating their employees through bulletins and otherwise to see that attacks on the reasonable prosperity of the railways are plainly, though indirectly, attacks on their own bread and butter. If the hundreds of thousands whose livelihood depends upon the welfare of public service corporations can be made to see how intimately their own conditions of employment or lack of it depend upon giving the companies a just

	Cents		Cents
General.			
Salaries and office expenses	.16		
Insurance	.025		
Pensions and rewards	.025		
			.210
Conducting Transportation.			
Cost of energy	.585		
Wages	1.45		
Removing snow	.01		
Other transportation expenses	.10		
			2.145
Maintenance of Roadway.			
Maintenance of roadbed	.185		
Maintenance wires	.05		
Maintenance car houses	.045		
		.28	
Maintenance of Equipment.			
Maintenance of cars	.175		
Maintenance motors, etc.	.22		
Maintenance other equipment	.015	.41	
Depreciation		.08	.770
Damages and legal expenses			.300
Direct Payments to Public.			
Taxes	.355		
Rental subway and East Boston Tunnel	.10		
			.455
Other Fixed Charges.			
Interest	.365		
Rentals	.47		
			.835
Dividends			.285
Total			5.00

hearing and a fair return, the situation cannot but be measurably improved.

Following Mr. Sergeant, Mr. P. F. Sullivan, president of the Boston & Northern Street Railway Company, corroborated Mr. Hedley and voiced the appearance of improved conditions in his present observation. He urged the benefits of honest business dealing in the administration of all public service corporations.

After the above meeting, the Boston *News Bureau* printed an outline of the financial situation of the Boston Elevated Railway Company for the benefit of the public, which naturally looks upon this corporation as one of unlimited wealth and power.

The *News Bureau* series takes up the main question of capitalization, pointing out that in Boston for every dollar of securities issued more than a dollar has gone into the property, and showing just where the nickel goes under present conditions. It is shown that the company is engaged in the business of retailing transportation, and that patrons of large retailers in other lines know and expect that a considerable part of their purchase money is profit for the merchant, even with the modern business maxim of large sales and small profits. A summary of the disposition of each nickel is given in the table on page 775, the data being for the Boston system.

The net result is that only about one-fourth of a cent out of each nickel is available for dividends in this property, which is known the world over for its able administration and sensitive regard for the desires of the traveling public. It is significant that nearly half a cent out of each fare collected goes into the public treasury through taxation.

The most direct local appeal that has thus far been made to the public in the interest of educating it to the situation of the electric railways in Massachusetts as a whole is found in an article printed in the Boston *Transcript* of Feb. 27 from the pen of Mr. Frederic W. Coburn. This writer reviews the conditions in a clear and straightforward manner, showing how the three-cent fare has failed in Cleveland and indicating that even the five-cent fare may be inadequate on large systems as transfer privileges extend and as the cost of living rises. The net result of this campaign, which is now well under way, is likely to be a consideration at no very distant day of an extra charge for a transfer to other systems.

Meeting of Boston Section, A. I. E. E.

A meeting of the Boston section of the American Institute of Electrical Engineers was held on March 17, when Dr. C. P. Steinmetz reviewed his paper on "Prime Movers," as read recently before the Institute in New York. In discussing the paper, Dr. A. E. Kennelly called attention to its interesting character, particularly on account of the great scope which it covers. Thus, in its first section it took up the economy of prime movers, then passed to the questions of service continuity and reliability, and concluded with an analysis of the physical features of the various types of prime movers. Dr. Kennelly said that it is very fortunate that the analysis does not show that one particular kind of prime mover is superlatively good and the other bad.

Regarding the gas turbine Dr. Steinmetz stated that considerable work has been done. The difficulty is not in the gas turbine itself so much as in the compressor. In a gas cycle the gas must first be compressed, after which combustion follows and then expansion. One can have a combustion chamber where the combustion takes place at moderate pressure, and by combustion there the volume of the compressed air and gas is increased in temperature and the air is sent against the turbine blades. When the air is very hot this might be a little difficult, but there are now available materials which can withstand high temperatures. The real difficulty is due to the fact that the compressor is not economical. In the steam turbine the boiler produces steam, but with the gas turbine the air must first be compressed. Turbine and centrifugal compressors are too inefficient to be used, because after all in any air cycle the output is the difference between the work of compression and the expansion at higher temperature and higher volume. If the compression is at low efficiency one is liable to consume more power than is secured by expansion. This condition would give a negative output. If one could find an efficient compressor the gas-turbine problem would be solved probably in a very short time. The turbine itself presents the least trouble.

Prof. Elihu Thomson said that experiments have been carried on for a long time at Lynn in regard to the gas turbine. Use had to be made of the reciprocating compressor, which, of course, might as well have been a gas engine. If one considers the matter of compressing by stages with air, the efficiency does not work out properly and from 50 to 60 per cent is a high value. Professor Thomson stated that if oil is used it can be pumped into the combustion chamber, but when air is used it is necessary to employ two compressors, one for gas and one for air at, say, from 12 to 15 atmospheres, so that the conclusion is that the only possible room for a gas-turbine arrangement would be one working at low pressures, probably not more than two or three atmospheres. It may be possible to get these pressures in a large volume by ordinary centrifugal arrangements.

An inquiry was made about the useful life of prime movers, on the understanding that the useful life of a reciprocating engine is on the same basis as the useful life of a turbine or gas engine, because the latter are rapidly improving. The question was if the economy of the steam turbine and the gas engine are equal to or superior to the economy of the reciprocating engine, and what tests have established, if any, the economy of the steam turbine above that of good reciprocating engines. Dr. Steinmetz replied that at present the field is fairly divided between the reciprocating steam engine and the steam turbine. The general co-economy of the two types is fairly the same. Possibly the turbine is a little more efficient because it is increasing at a greater rate in its use than the steam engine. There cannot be any great difference in steam consumption between the two prime movers because if there were, one of them would not be used as much. If the steam consumption of the turbine be decreased by 10 per cent the steam turbine would be much more economical under average conditions than the steam engine. The latter would then have to give way to the steam turbine.

Dr. Steinmetz said that there is a decrease in consumption of approximately 8 lb. or 9 lb. of steam per kw-hour between the old steam turbines installed in the Fisk Street station, Chicago, and the new ones which are being installed. The old ones took about 21 lb. of steam and the new ones, to the best of his recollection, take a little less than 13 lb. Incidentally the machines are of the same size, and the rating of the station is increased some 30 per cent without increasing the space, by simply replacing the old turbines by new units. These operate at 175 lb. and 150 deg. Fahr. supertemperature. The efficiency curve is nearly flat from 75 per cent load to 25 per cent overload.

Proposed Railroad Subways in Chicago.

The Illinois Central Railroad Company is committed to the electrification of its Chicago terminal, including the extensive suburban passenger service. When its trains are electrified they could be easily operated in a subway connecting the Illinois Central terminal with the other five great steam railroad terminals in Chicago. This idea of a railroad subway is said to appeal to the Illinois Central officials, but Mayor Busse, of Chicago, is reported to have declared that such a subway, if built, shall not be exclusively an Illinois Central affair, but shall be for the use of all the railroads. However, the other railroads have not yet agreed to electrify their terminals, although they seem to think that the idea of a subway connecting these terminals is a good one. The matter has received some discussion apropos of the recent report of the local transportation committee of the Chicago City Council on street-railway subways, a summary of which appears elsewhere in this issue. It is probable that the matter of street-railway subways will be disposed of before the question of a subway to connect the terminals of the trunk-line railroads is seriously taken up.

Meter Charges in Boston to Be Discussed.

A petition has been filed by Joseph J. Leonard and others of Boston with the Massachusetts Gas and Electric Light Commission, claiming that the meter charge of $1 per month, made by the Edison Electric Illuminating Company, when the energy consumption is less than that amount in value, is excessive. A hearing will be given by the board on April 6, at its office in Boston.

Award of John Fritz Medal.

The John Fritz Medal for 1909 has been awarded by the board of award specially selected for the purpose and consisting of four members of each of the national engineer societies, to Mr. Charles T. Porter for his work in advancing the knowledge of steam engineering and in improvements in engine construction. The public ceremony of the presentation of the medal to Mr. Porter will take place in the large auditorium of the Engineering Societies Building, 29 West Thirty-ninth Street, New York, at 8:30 p. m. on Tuesday, April 13, 1909. It is the wish of the board to give distinction to the event and to make these awards year by year memorable and fittingly conspicuous. Members of all branches of the profession are therefore particularly invited to be present, and particularly of those represented in the four national organizations of engineers participating in the creation of the medal fund. Besides the simple ritual of the presentation of the medal, in the presence of invited guests and distinguished representatives of engineering, there will be addresses by representatives of the four groups of the profession most concerned, as follows: "The Debt of Modern Industrial Civilization to the Steam Engine as a Source of Power," by Dean W. F. M. Goss, of the University of Illinois, member A. S. M. E. and A. I. E. E.; "The Debt of the Modern Steam Engine to Mr. Charles T. Porter," by Prof. F. R. Hutton, of Columbia University, honorary secretary, A. S. M. E.; "The Debt of the Era of Steel to the High-Speed Steam Engine," by Mr. Robert W. Hunt, of Chicago, member A. S. C. E. and past-president A. S. M. E. and A. I. M. E.; "The Debt of the Era of Electricity to the High-Speed Steam Engine," by Mr. Frank J. Sprague, of New York, past-president A. I. E. E., member A. I. M. E. and A. S. C. E. Mr. Henry R. Towne is chairman of the board of award. The committee of arrangements consists of Messrs. Henry R. Towne, Charles Warren Hunt, Charles Kirchhoff, Schuyler Skaats Wheeler and F. R. Hutton.

N. E. L. A. Convention Exhibits.

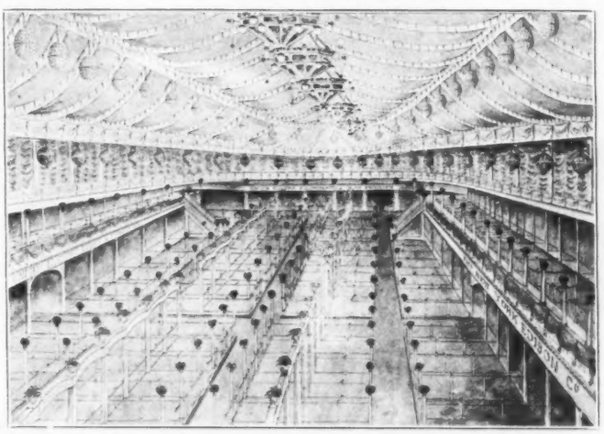
The exhibition to be held in connection with the coming meeting of the National Electric Light Association at Atlantic City June 1-4, will be held in the main building of Young's Million-Dollar Pier. The booths will have twice the floor area of those of last year, namely 135 sq. ft., and will be arranged in horseshoe form, leaving in the center a space approximately 70 ft. wide by 140 ft. long. It is planned to furnish this space with rugs, rockers, chairs and tables, and make it a "Convention Exchange." It is believed that under this arrangement every one of the 49 booths will have equal advantages, and preferred locations will be practically eliminated. The booths will be furnished in every detail, including two sign boards, and will be covered with matting. Backs of burlap will extend to a height of 7 ft., and side partitions to a counter height. The principal sign board will extend the length of the booth at the back, and will be 10 in. high. The secondary sign will be somewhat smaller, and will hang below the principal sign. Both direct and alternating current at 110-220 volts (3-wire) will be available for the operation of exhibits.

Abandons Free Lamp-Renewals.

At the Minnesota Electrical Association convention, March 19, Mr. N. M. Argabrite, manager of the Winona Railway & Light Company, Winona, Minn., announced that his company on Jan. 1, 1909, did away with all free lamp-renewals. It had been the policy of the company formerly to furnish free renewals of common carbon-filament incandescent lamps. This action is partly the result of the coming of the tungsten lamp. The Winona company now retails 16-cp carbon lamps at 20 cents and tungsten lamps at list price. There are two contractors and dealers in the town who also sell lamps.

Third Annual New York Electrical Show.

Active preparations have already begun for the New York Electrical Show to be held in Madison Square Garden next October, and the management is putting forth every effort to make it the finest exhibition of the kind ever given. The decorations, illumination and general arrangement of the exhibitors' spaces will be distinctly novel, and the whole interior will present a uniform appearance. The accompanying illustration is reproduced from a sketch giving the main features of the



VIEW OF DECORATIONS AT MADISON SQUARE GARDEN.

decorations. A new departure has been inaugurated this year whereby the space sold to exhibitors will include decorations and current for lighting. This will relieve the manufacturers from much detail work, and make it necessary only to install and remove exhibits. Especial attention will be given to working industrial exhibits, and there will be a great display of electrically operated machinery representing many classes of manufacturers.

Chemical Extinguisher for Electric Fires.

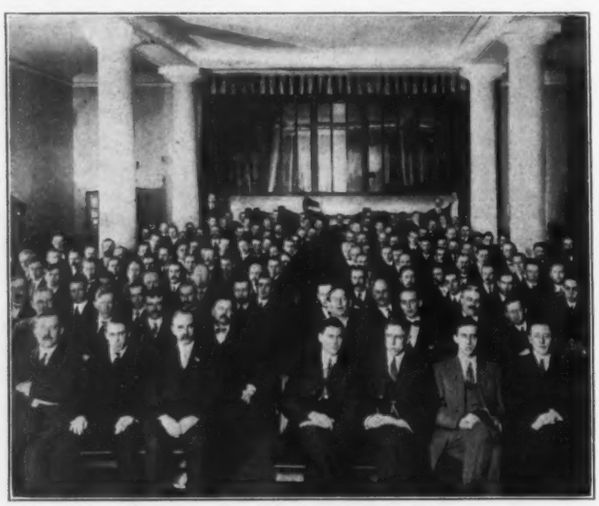
On Friday afternoon, March 26, a test was made in Waterside Station No. 1 of the New York Edison Company with a new chemical fire extinguisher called "Pyrene," said to be a non-conductor of electricity and to possess valuable fire extinguishing properties. The substance is a combination of gases in liquid form and is put up in a small vacuum pump. The actual make-up of the liquid is not ascertainable, but chemical tests show it to contain chiefly carbon tetra-chloride. In order to show the liquid to be non-conducting, an arc was formed between the leads of a three-phase cable under a tension of 14,000 volts. The liquid was squirted at the arc and extinguished it without the operator feeling any effects whatever. The substance was then tried on a direct-current circuit of 250 volts. Arc lamp carbons were bunched together so as to form two electrodes about 4 in. in diameter. The circuit was completed through a water rheostat and a current of approximately 4000 amp passed from a motor-generator set. The operator maintained an arcing distance of approximately 1 in. and all attempts to extinguish the arc with the small pumps on hand were futile. The chloride fumes were also very trying on the lungs of the operator and the spectators invited to witness the demonstration. The liquid was then squirted all over the commutator of a 5-hp, direct-current motor in operation and also on the armature and field coils without apparently affecting the operation of the motor. Outside the station the substance was successfully applied in extinguishing calcium carbide fires, gasoline fires and burning saturated waste. The liquid is said not to injure material with which it comes in contact and to be independent of climatic conditions. It evaporates quickly, giving off inert gases which do not support combustion.

Boston Edison Employees' Club.

Several years ago the management of the Boston Edison Company sought, in common with other large corporations, to encourage a community of interest among its employees that would lead to closer harmony of social interests throughout the organization. In the early days officers and men were closely associated, seeing each other every day, and the social life was coincident with the business activity. As the company grew, however, this intimate relation necessarily suffered to some extent. At no time, however, did the officers lose interest in those under their authority, but always kept in mind the possibilities of some organization that would bring them all together from time to time, not to be criticized nor crowded to increased activity, but for the sake of the mere pleasure and entertainment to be found in "getting together."

A club was started among the employees and the results were satisfactory for a time, but the scope of the organization was not as complete as general experience in corporation development has proved possible in later years. It was found that a wider range of interests must be included. The list of employees was constantly increasing and it was useless to keep up a club organization unless the plans included "what everybody liked."

As a result the present Edison Employees' Club was organized under a new set of by-laws in October, 1907, "For the purpose of instruction and entertainment and to promote a closer feeling of friendship between the employees of the many departments of the company."



BOSTON EDISON EMPLOYEES' CLUB.

From the first the new club has proved remarkably successful. Of the 850 employees of the company over 600 are now members. There is a small initiation fee, together with annual dues, which afford a fund from which the expenses of the numerous entertainments can be defrayed. These small payments by the members stimulate their interest in making the club active. Of course, the membership includes the employees in every department, messenger boys, clerks, stenographers, linemen, electricians, firemen, engineers, oilers, bookkeepers and all of the officers of the company, including president and general manager, Chas. L. Edgar, and general superintendent, Wm. H. Atkins. Every one takes an active interest and gives his ideas as to what should be done for entertainment and for improving the time through co-operative study or in classes that attend lecture courses.

The club holds its regular meeting on the first Friday evening of each month in the auditorium of the Edison Building, 39 Boylston Street. The management of the company has set aside the entire third floor of this building for the convenience of the employees, especially club members. The room is fitted with a stage, upon which plays and vaudeville entertainments are given. There is ample and comfortable seating capacity, and the conveniences are all that can be found in the modern clubroom. There is a complete library of books on electrical subjects, together with some fiction, and files of the daily papers as well as of all leading technical magazines are maintained. Broad tables and comfortable chairs make the library room an attractive place for reading and study, and it is open generally throughout the day for the accommodation of people in the company.

The club meetings are devoted chiefly to forms of entertainment, it being regarded as specially important to provide for suitable recreation. After the meetings the chairs are cleared away and dancing is enjoyed, and frequently light refreshments are served.

One specially important feature of the club work this winter is a course of lectures on "Electrical Engineering" by Prof. Sydney W. Ashe, of New York. These lectures started with the elementary principles of electrical work, profusely illustrated by the use of a stereopticon and with experiments which Prof. Ashe makes before his audience. He will take the class through almost the entire field of practical work in electricity. There will be 20 of these lectures, coming on every Thursday until next June. To accommodate those who must work through the silent watches of the night, the lecture is given at 1 o'clock in the afternoon, and repeated at 7 o'clock in the evening for those who are at work during the day. A small additional fee is charged those who attend these lectures, but nearly the entire membership has joined the course.

The young women employees of the company are as interested in the success of its work as are the men. They attended in large numbers every monthly meeting, and took upon themselves the program for the March meeting. The entertainment included a short play, "The Bachelor's Dream," tableaux, vocal and instrumental solos. The men will give a similar entertainment in June.

The annual dancing party of the club was held in Paul Revere Hall, Mechanics' Building, on February 12. This is always a social function in the company, attended by nearly all the employees, each of whom has the privilege of inviting one friend.

Bowling contests have been especially followed with keen interest by the club members this winter. Each department of the company selected a team after competitive contests among the applicants, and the bowling series have been carried on with enthusiasm. Many creditable scores have been rolled up. The same plan of selection is adopted in the summer for the organization of baseball teams, so that each department gets out its best ball players for a series of games in what may be very properly called the Edison League. For two years delightful outings have been held, at least once each summer, at some one of the shore resorts, and plans are already formulated for the one next summer.

The management of the club is under the direction of an executive committee, composed of one member from each department of the company, who is elected by the club members in his department. The officers are as follows: President, Mr. H. W. Moses; first vice-president, Mr. L. L. Elden; second vice-president, Mr. W. L. Frisbie; secretary, Mr. John J. Buckley; treasurer, Mr John H. Guy; assistant treasurer, Mr. T. T. Golden. This committee is sub-divided into entertainment, athletic and house sub-committees.

Massachusetts Legislative Notes.

The committee on mercantile affairs has reported adversely to the House in the case of the Dean bill, which required that the rate for a single telephone call for three minutes should not exceed 5 cents between Boston and any place within a 15-mile radius. The committee also reported leave to withdraw to the Senate on the Abbott bill to set a 5-cent maximum

charge similarly in the limits of the city of Boston. It refused to favor the Guild bill to allow the Massachusetts Transmission Company to take land for the purpose of power distribution by electricity. The bill gave the right of eminent domain, subject to final review by the Gas and Electric Light Commission. The committee on education has reported a bill providing that the State shall pay half the expenses of maintenance when the commission on industrial education certifies that a city or town has appropriated funds for the maintenance of an industrial school. The committee on labor has reported leave to withdraw the Ross bill restricting the hours of labor of women and minors employed by public-service corporations. The Senate has accepted the adverse report of the committee on mercantile affairs on the Ives bill for legislation relative to cutting wires for the moving of buildings. The House has accepted the committee's adverse report on the Ives bill providing special police officers for gas, electric light, telephone and telegraph companies.

Annual Meeting of the New England Street Railway Club.

The annual meeting and banquet of the New England Street Railway Club were held at the Hotel Somerset, Boston, on March 25. Mr. W. D. Wright, of the Rhode Island Company, Providence, was elected president for the ensuing year. The club has now a total membership of 727, and has been a power in electric-railway circles for the past nine years. Among the speakers at the banquet were Mr. D. L. Prendergast, Boston, toastmaster; State Treasurer Chapin, of Massachusetts; Mr. James F. Shaw, president of the American Street & Interurban Railway Association; Mr. James F. Jackson, recently chairman of the Massachusetts Railroad Commission, and Mr. P. F. Sullivan, president of the Boston & Northern and the Old Colony Street Railway companies. Mr. Jackson defended the policy of permitting railroad monopoly under wise regulation and laid special stress upon the spirit in which laws and policies should be administered. He said that supervision may be carried so far into details as to become wasteful and burdensome; public control cannot be too scientific or it will call to mind the surgical operation that is a perfect success, followed by the death of the patient. If railroad arrogance is to be followed by official conceit and intolerance, and the evils of the past are to be exchanged for an oppressive and obstructive governmental policy, men of the ability which the service demands will leave it, and a weaker conduct of affairs will only hasten the day of public ownership. Mr. Shaw alluded to the popular prejudice against public service corporations and asked the fair-minded public to meet them half way.

CURRENT NEWS AND NOTES.

EX-SECRETARY CORTELYOU HEAD OF CONSOLIDATED GAS.—Ex-Secretary George B. Cortelyou has been elected president of the Consolidated Gas Company of New York City, which organization controls all of the larger electric lighting companies of Greater New York.

EIGHTY-CENT GAS IN LYNN, MASS.—The Lynn Gas & Electric Company has announced that the price of gas will be reduced from 90 cents to 80 cents per thousand cubic feet, beginning July 1. The electrical department of the same company supplies 446 direct-current arcs, 536 alternating-current arcs, 60,000 incandescent lamps and 4300 hp in motors.

MEETING OF THE ELECTRIC RAILWAY GENERAL MANAGERS' ASSOCIATION.—The Electric Railway General Managers' Association, which held its previous meeting in Lexington, Ky., will hold its next meeting in Fort Wayne, Ind., May 26. The Lexington meeting was given up to discussion of operating questions and purchasing operating material.

GROWTH OF AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.—Between Sept. 30, 1908, and Feb. 15, 1909, 35 electric railways have joined the American Street and Interurban Railway Association, thereby increasing by 13.5 active members in four months. In the same interval 369 associate members have joined the association, increasing this grade no less than 148 per cent.

BROOKLYN ENGINEERS' CLUB.—The Brooklyn Engineers' Club will remove May 1 from its present quarters, 197 Montague Street, to its new home, 117 Remsen Street. The club, which has between 300 and 400 members, was formed 13 years ago. Its objects, however, are rather those of a society than a club, among these objects being the advancement of engineering knowledge and practice, and the maintenance of a high standard of professional ethics.

WORCESTER SECTION AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The regular meeting of the Worcester Polytechnic Institute branch of the American Institute of Electrical Engineers was held on Friday evening, March 26. Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, gave an illustrated lecture on the "Electrification Problem in Steam Railroad Work," with special reference to the New Haven installation.

LYNN GENERAL ELECTRIC DINNER.—The 11th annual dinner of the General Electric Company to its employees was given at Lynn on March 19 at the American House. Two hundred and fifty were present at the dinner, including a delegation from Schenectady. Mr. Charles E. Pierce acted as toastmaster. Dr. A. E. Kennelly spoke on the subject of wireless telegraphy with particular reference to the Fessenden plant at Brant Rock. Prof. Elihu Thomson and Dr. C. P. Steinmetz participated in a following discussion of wireless.

RIFLE ELECTRIC LIGHT.—Among the rifles taken with him by ex-President Roosevelt are two equipped with small electric lights at the gun sight, to enable accurate shooting to be done at night. On each side at the tip end of the gun is a miniature electric lamp. On the under side of the rifle stock is a small dry battery, and a button on the trigger guard enables the electric circuit to be completed. Upon pressing the button the light on the barrel brings the rifle sight into clear view of the shooter, thereby enabling him to aim accurately.

ELECTRICITY FROM THE SUN'S RAYS.—Messrs. E. J. Dickey and G. H. Cove, of Haverhill, Mass., claim to have invented a method whereby the sun's rays can be directly utilized for the generation of electrical energy, and have completed an experimental apparatus to demonstrate their claims. The sun's rays fall on the face of plugs "of a special alloy" which protrude through a cement block about 1 in. The difference in temperature between the extremities of the plug gives rise to a difference of potential, and the resulting electric current is stored in storage batteries. It is claimed that a block 5 ft. square will store from the sun on a clear day sufficient energy to light five 16-cp lamps for a period of four or five hours.

ELECTROCHEMICAL SOCIETY.—The New York section of the American Electrochemical Society will hold a meeting at 8:15 p. m., on April 2, at the Chemists' Club, 108 West Fifty-fifth Street. Prof. W. D. Bancroft will present papers entitled "The Chemical Electrolysis of Acetates" and "Electrolytic Production of Anilin." Two papers entitled "A Modified Oxyhydrogen Gas Coulometer" and "A New Form of Laboratory Apparatus" will be presented by Dr. J. W. Turrentine. Mr. Maximilian Toch will read a paper on "The Protection of Steel Against Corrosion." The annual meeting of the society will be held on May 6, 7 and 8, at the Clifton Hotel, Niagara Falls, Canada. The membership of the society is now about 1000.

BOSTON I. E. S. SECTION.—The Boston Section of the Illuminating Engineering Society has taken measures to extend its usefulness through the appointment of a number of committees to forward actively plans to render the section of the greatest possible service to its members and to the art of illumination. The next meeting of the section will be held April 20.

THOUSAND MILES BY TROLLEY.—Mr. A. A. Anderson, president, and other members of the Central Electric Railway Association, which met in Cleveland last week, made the journey from Louisville to that place in a private electric car via Fort Wayne, Ind., and will return in the same manner. The total distance of the round trip falls but a few miles short of 1000 miles.

NEBRASKA ELECTRIC LIGHT CONVENTION.—The 1909 convention of the Nebraska Electrical Association is to be held at Omaha, May 11, 12 and 13, during the Omaha Electrical Show. The Millard Hotel has been selected as headquarters, and all of the sessions will be held there, as last year. The secretary of the association is Mr. Wm. Bradford, of the Lincoln Gas & Electric Light Company.

AUTOMOBILE CLUB TAKES UP AERONAUTICS.—The Automobile Club of America has made an agreement with the Aero Club of America whereby the latter becomes the "Aviation Section" of the former. This is in accordance with a decision at the recent international Paris automobile congress, that automobile clubs should occupy themselves with means of aerial flight in which light gasoline motors are employed.

NORTHWESTERN UNIVERSITY ENGINEERING DEPARTMENT.—On March 25 the Northwestern University at Evanston formally inaugurated the Swift Hall of Engineering, a $100,000 building presented by Mr. Edward F. Swift and his mother, together with $50,000 for maintenance. The university some time ago formulated an organization for engineering instruction, which will go into full force the beginning of the next school year.

CHICAGO PARK LIGHTING.—The Forest Park Fair Grounds & Amusement Company, of Chicago, has entered into contract with the North Shore Electric Company to secure electricity to light its grounds and some of the buildings. The Sanitary District of Chicago had a pre-existing contract to supply electricity to this suburban amusement park, and the new contract is of especial interest because it is supplemental to the older contract.

HIGH-TENSION TRANSMISSION.—At the meeting of the American Institute of Electrical Engineers, to be held in New York April 9, a working demonstration of high-tension insulators will be made by Mr. A. B. Reynders, who will present a paper entitled "Condenser Type of Insulation for High-Tension Terminals." High-voltage transformers and protective and controlling apparatus for outdoor installation will be discussed in a paper by Mr. K. C. Randall.

ARKANSAS PUBLIC UTILITY OPERATORS.—The second annual convention of the Arkansas Association of Public Utility Operators will be held at Hot Springs on May 12, 13 and 14, with headquarters at the Arlington Hotel. In addition to the address by the president, Mr. D. A. Hegarty, papers will be presented by Messrs. J. M. Hewitt, S. A. Stearns, B. C. Fowles, C. J. Griffith, J. E. Cowles and S. E. Sawyer. Tungsten lighting will be discussed by Mr. Cowles.

NON-RESIDENT LECTURES AT THE UNIVERSITY OF MINNESOTA.—Mr. Edward P. Burch, consulting engineer, Minneapolis, is giving a course of 10 lectures on "Electric Traction for Railway Trains," at the College of Engineering of the University of Minnesota. The lectures include a history of electric traction; advantages of electric traction; characteristics of steam and electric locomotives; motor-car trains; electric-railway motors; power required for trains; steam, gas and water-power plants; the transmission system; electrification of steam railroads.

ELECTRIC RIVETING MACHINE.—A consular report describes a recent type of riveting machine made at Oerlikon, Switzerland, which combines the mechanical advantage of hydraulic riveting and the economy of electric power. An expensive generating plant is necessary for pneumatic riveting, while the hydraulic-electrical apparatus, which weighs 2750 lb., is complete in itself, is easily transported and can be suspended for operation horizontally or vertically. The motor operating the hydraulic arrangement is of 5 hp and designed for an alternating current at 240 volts.

BILL TO REGULATE TELEPHONES.—A bill has been introduced in the Legislature of New York prohibiting telephone pools, trust agreements and combinations. It also requires all long-distance telephone companies and all local exchanges to admit telephone connections at all exchanges with all rural lines applying therefor at the maximum rate of 25 cents per month for switch charges for each telephone on any rural line admitted and fixes minimum rates to be charged for messages according to the distance, 10 cents being the rate for messages sent a distance of 15 miles or less. The violation of the pool and trust provisions is subject to fine or imprisonment or both and forfeit of franchise.

ELECTRIC CLUB OF CHICAGO.—An address rather out of the ordinary, but nevertheless greatly appreciated, was delivered at the weekly luncheon of the Electric Club of Chicago on March 24 by Judge Frederick L. Fake, of the Municipal Court. The speaker talked about the general principles of the law and its administration by the courts, referring both to civil and criminal law, with something about the law of contracts. The burden of the talk was to the effect that if men endeavored to do right in their relations with other men and conducted themselves in a reasonable and prudent manner, the law should have no terrors for them. It was announced that Prof. A. A. Radtke, of Armour Institute of Technology, would address the club at the meeting of March 31 on the subject of "Public Service Commissions."

PUBLIC SERVICE COMMISSIONS LAW.—In a privately printed pamphlet entitled "The Shortcomings of the Public Service Commissions Law of the State of New York," the statement is made that certain statistics quoted were compiled by the secretary of the Empire State Gas & Electric Association. We are informed by the secretary of that association that the figures quoted are merely a summary of figures given in the commission's statistical report, and that neither the secretary nor the association is responsible in any way for the publication of the pamphlet nor for the opinions expressed therein. The pamphlet vigorously attacks the New York Public Service Commission whose activities, it is predicted, will, if continued, deprive the Empire State of its long-continued supremacy.

MISSOURI ELECTRIC CONVENTION.—The third annual convention of the Missouri Electric Light, Gas and Street Railway Association will be held at the Colonial Hotel, Springfield, Mo., on April 15, 16 and 17. The presidential address of Mr. W. B. Hays will be delivered in the forenoon on April 15. The tungsten lamp will be treated from the viewpoint of the central-station manager by Mr. Paul J. M. Loewe. Mr. C. W. Hough will read a paper entitled "Insurance on Public Service Plants." High-tension transmission will be discussed by Mr. O. Wiemer. Prof. H. B. Shaw will present a paper dealing with engineering equipment stations. "Records," by Mr. P. A. Bertrand; "Equitable Rate-Making," by Mr. C. W. Hough; "Office Systems and Accounting," by N. J. Cunningham, and "Building of the Day Load," by E. L. Callahan, are the titles of other papers to be read and discussed.

Plant of the Lee Electric Light Company at Clarinda, Ia.

THE city of Clarinda, Ia., has a population of about 4000. Electricity for all purposes is furnished by the Lee Electric Lighting Company, which also manufactures ice, pumps water and supplies steam for heating purposes. Inasmuch as the company did a business in 1908 amounting to $55,000, yielding a revenue of approximately $14 per capita, a detailed description of the generating station, together with some notes on the company's methods of conducting its business, will be of interest.

In September, 1902, when the station was first started, Clarinda had a small, direct-current plant, consisting of two Hawkeye generators and a Gates high-speed engine. This station was owned by the Clarinda Electric Light & Power Company, whose business amounted to approximately $8,000 per year. Mr. J. Ren Lee and Mr. Rufus E. Lee formed a copartnership and started in opposition to the company, having obtained a franchise in February, 1902. The business grew so rapidly that in January, 1905, it was decided to incorporate the company under the name of the Lee Electric Light Company. The company was granted a new franchise for furnishing electricity, heat and gas.

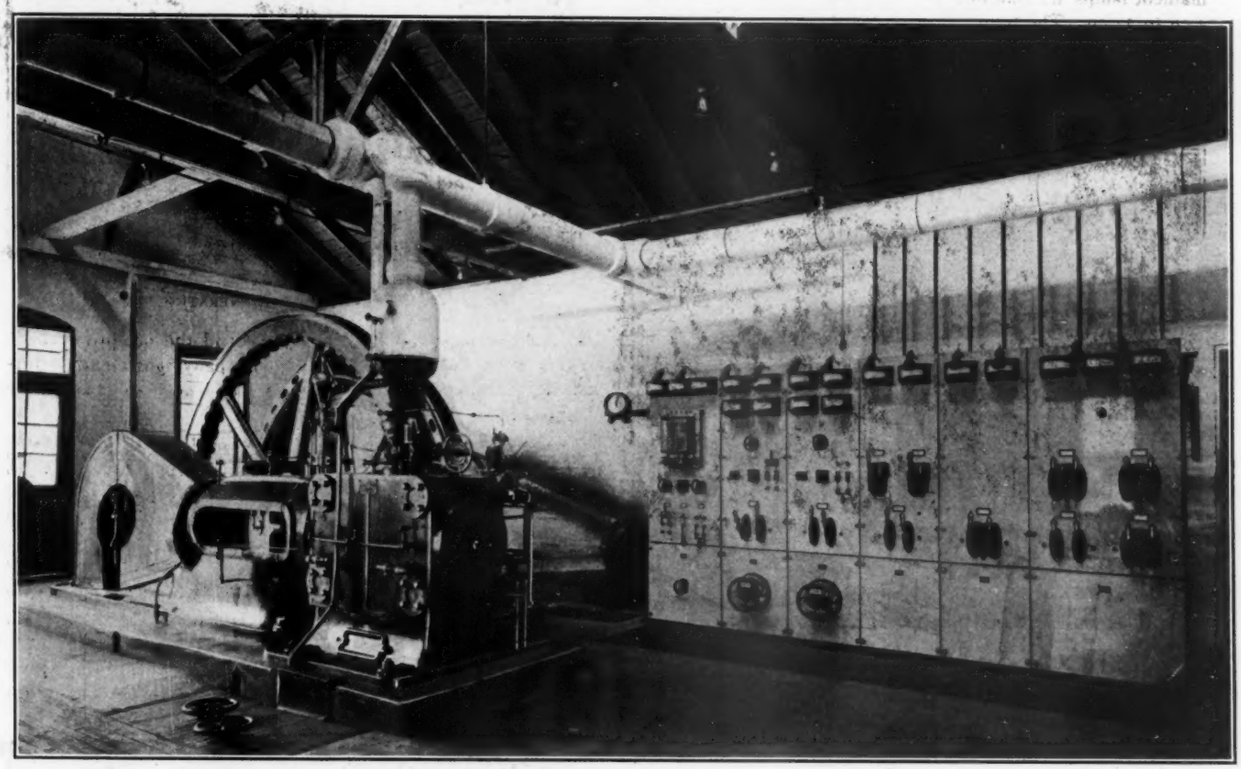


FIG. 1.—GENERATOR ROOM OF THE LEE ELECTRIC LIGHT COMPANY.

A view of the generator room of the company's station, which operates 24 hours a day, is shown in Fig. 1. The equipment comprises four return tubular boilers, equipped with Jones stokers, manufactured by the Under-Feed Stoker Company of America; three Murray Corliss engines, one of which is direct connected to a 150-kw, two-phase, 60-cycle, 2200-volt generator; another connected by rope drive to a 100-kw, two-phase, 2200-volt Warren alternator, and the third direct connected to a 15-ton Linde compressor. The new switchboard shown in Fig. 1 was added to the plant in 1907, and the alternators are operated either single or in parallel, the voltage of the circuits being controlled by a Tirrill regulator.

Two feed pumps are located in the basement, and, as all the steam mains are brought into the basement from the heating system, that portion of the plant was naturally quite hot. Advantage was taken of this condition, however, by placing the fan blower forming part of the stoker equipment in such a position as to draw its supply of air from this part of the basement, and thus not only to lower the temperature in that portion of the plant, but at the same time furnish heated air to the stokers.

Fig. 2 shows a view of the boiler room. The stoker equipment here shown was installed in 1907, and the fuel used is Iowa slack. During the winter months steam heat is furnished to the buildings in the business center, as well as to a limited number of residences. The city's water supply is pumped from this station, as is also an independent supply for the Chicago, Burlington & Quincy Railroad Company's tanks. The water delivered to the tanks is used for locomotives, so that there is no particular advantage in having it cold; in fact, it is conducive to economy to have the water warm. It so happened that the electric light company could kill two birds with one stone, not only delivering tepid water to the railroad company's tanks, but also utilizing the water first for condensing purposes, passing it over condenser coils in the plant before delivery.

The ice factory has been in operation for four years, and, together with the cold storage department of 25,000 cu. ft. capacity, has proved a very profitable branch of the business. The company thus controls commodities which cover a range of utilities, excepting electric railways, which in a town of this size would hardly be required. The various commodities are produced in seasonable combination, so that the entire steam output of the station is fully utilized, both directly and in auxiliaries, throughout the year, and the cost to the consumer of any service is quite reasonable.

The city lighting consists of 80 4-amp, 110-volt, 60-cycle Adams-Bagnall arc lamps, which burn every night until 1 o'clock, the city paying for the same at the rate of $42.80 each per lamp. Since the power house is located very near the center of the town, it was found advisable to divide the lamps on three single-phase circuits, which are used in balancing the load. From the station a 2200-volt primary circuit is run to the manufacturing part of the town for the purpose of supplying all motors with 220-volt, four-wire, two-phase service.

Clarinda is built around the public square, and, as this is

very evenly built up, the company has experienced no difficulty whatever in balancing the phases. Large transformers are placed at four different points around the square, and a network of three-wire, 110-volt circuits supplies the lamps in this portion of the city.

On the first of the year, or approximately six years after the plant was placed in operation, the company had 450 meters in service; three-fourths of these are rented at a rate of 25 cents per month, and all customers are charged a minimum of $1 per month, exclusive of the meter rental. During the year 1908, 482,180 kw-hours of energy were generated, and the company's receipts from the sale of energy during the year were approximately $28,000. Energy is furnished to 48 motors, ranging in rating from 1 hp to 20 hp, and aggregating a total of 275 hp, not including motors under 1 hp. The company further has in service 150 desk and ceiling fans, and about 75 flatirons. It furnishes energy to every concern in the town using electricity for motors, with the exception of one, a rolling mill, and there is not a single gasoline engine in operation in Clarinda. Carbon-filament lamps are renewed free of charge in sizes ranging from 4 cp to 32 cp. The total number of 16-cp equivalents wired up is 7000.

The heating system consists of ordinary steam mains laid around the public square, and, with the exception of two side

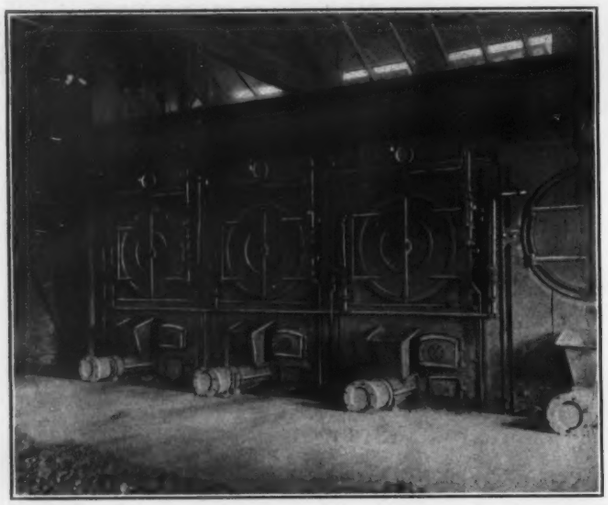


FIG. 2.—BOILER ROOM OF THE LEE ELECTRIC LIGHT COMPANY.

streets, this takes in all the district served. The company furnishes steam to 22,000 sq. ft. of heating surface, for which it receives an income of $5,600 annually. All radiation connection was installed in accordance with the company's specifications, but during the cold weather the company was able to heat every radiator in town with a back pressure of 3 lb., and in ordinary weather a back pressure of 2 lb. is carried. Condensation is returned to the station by gravity, and is used for boiler-feed purposes, and also for making ice. During the past year a few condensation meters were installed, but the greater part of the heating load is supplied on a flat rate.

The company does all the wiring in town, a very large part of which is placed in conduits. All the outside construction is of the best, the poles being neatly painted, strain insulators being installed on all guy wires running to the ground and nothing but the best material is used throughout. On junction poles all cross-arms are doubled, and galvanized hardware is employed exclusively.

The company's ice factory was erected in May, 1906, and has proved to be a good investment. The 15-ton ice machine installed was furnished by the F. W. Wolff Company, of Chicago, and during the past season 4922 tons of ice were manufactured, the income from which was, in round numbers, $12,000. The ice was sold at prices ranging from $2 to $5 per ton. During the winter season, as previously stated, the condensation from heating mains is returned to the station, and after it has been reboiled it is used for supplying distilled water to the ice factory.

The Lee Electric Light Company also does a merchandise and supply business. During the past year, aside from the work done in Clarinda, its income from this contracting work

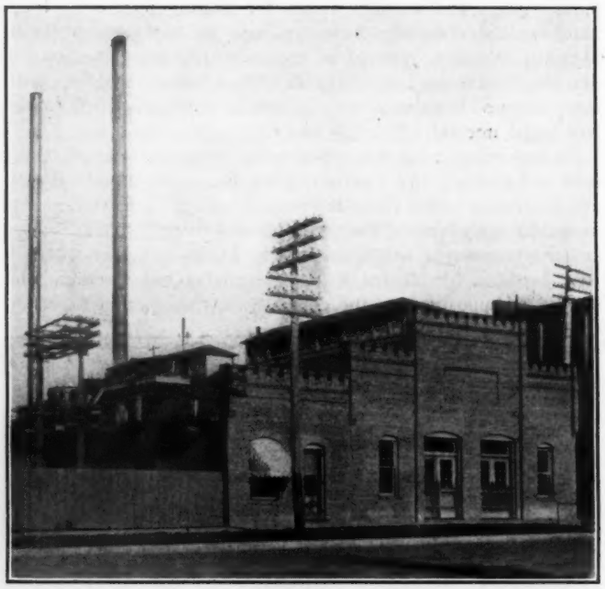


FIG. 3.—GENERAL VIEW OF GENERATING STATION.

amounted to approximately $10,000, and the net profit realized on this work was $2,300. The accompanying statement is furnished by the company, and shows the business done for the past year:

From electric light rentals	$28,000
From steam rentals	5,600
From fan rentals	300
From merchandise, net profit	2,300
From ice	12,000
Discounts taken on material purchased	200
Total	$48,400
Operating expense in round numbers	34,000
Net profit	$14,400

The above expense account includes a sum of $4,800, which is the depreciation estimated for the past year. This also includes an item of $620, which is set aside each year from a fund created to take care of any accident to employees or to the

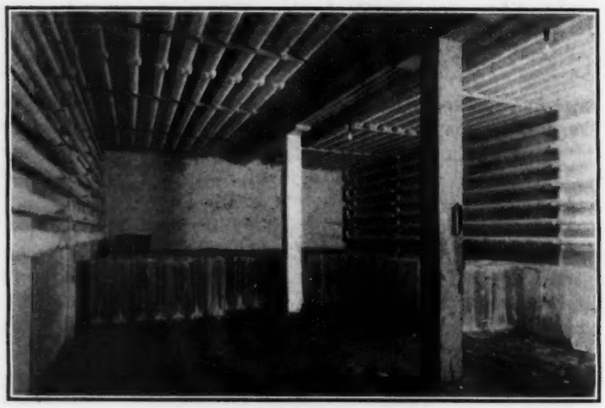


FIG. 4.—ICE STORAGE HOUSE.

plant. The company paid a 5 per cent dividend for each of the three years it was operated by the Lee Brothers, and during the first year of its incorporation a dividend of 7 per cent was declared. In the succeeding three years the dividend was 8 per cent. During that time there has been a charge for de-

preciation of approximately $13,000. The company is incorporated for $50,000, with a paid-up capital of $42,000, and $1,000 as treasury stock. Outstanding are $18,000 in bonds, against which there are assets amounting to $90,000. The station has been giving continuous service since June, 1905, and since August, 1905, has been fortunate enough never to have a complete shutdown. The maximum rate charged for electricity for lamps is 15 cents per kw-hour. The flat rate for steam is 30 cents and 50 cents on meter basis.

The officers of the company are as follows: President, Mr. William Orr; vice-president, Mr. G. William Richardson; secretary, treasurer and general manager, Mr. Rufus E. Lee. These officers, together with Mr. J. Ren Lee and Mr. A. F. Galloway, constitute the board of directors.

Wiring of the Babbitt Soap Factory at Babbitt, N. J.

THE wiring in the B. T. Babbitt soap plant on the Hackensack Meadows, at Babbitt, N. J., presents a number of interesting features. The conditions to be met in laying out the system were almost as rigidly fixed from the beginning as if electricity were to be installed in an old plant. Eleven principal and five subsidiary buildings were provided for in the plans, and the processes of manufacture determined the location of the power house at the southwest corner of the main group, as shown in Fig. 1 The significance of this position, electrically, will be appreciated when it is stated that the shortest feeder is 50 ft., and the longest 775ft. Electricity for motors is required only during the day, while energy for lamps is needed all night in one department, the glycerine building, and must be available in all other parts of the plant for emergencies. The installation was made to conform to the rules of the Associated Factory Mutual Fire Insurance Companies.

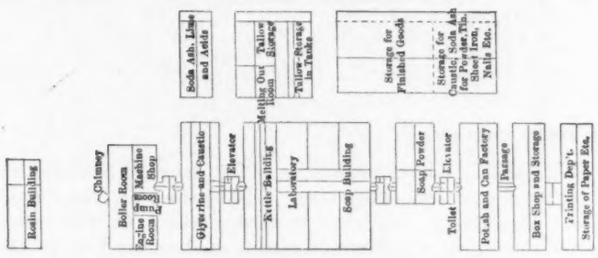


FIG. 1.—PLAN OF BUILDINGS.

The electrical energy is furnished by two Crocker-Wheeler 240-kw, three-phase, 60-cycle, 240-volt generators which are direct-connected to Buckeye engines. They run at 150 r.p.m. There are two exciters, one motor driven, the other direct-connected to a small Buckeye engine. The former is rated at 25 kw and is used for exciting both generators under ordinary conditions; the latter is a 50-kw machine and is used for starting up the plant and to carry the lighting load at night. Its size was determined by the lighting requirements.

The switchboard was built by the Albert & J. M. Anderson Manufacturing Company. It consists of two generator panels, one exciter panel, three motor and two lighting feeder panels. It is equipped with synchroscope, voltmeters, main and field ammeters and indicating wattmeters. A separate feeder for motor circuits is provided for each department in the works and each feeder has its own switch and watt-hour meter on the switchboard. In addition, there is one polyphase watt-hour meter to record the total alternating-current lighting load and one watt-hour meter for the total direct-current lighting load. The main switch for the 50-kw exciter is double-throw and connects the machine with either the exciting busbars or the direct-current lighting busbars.

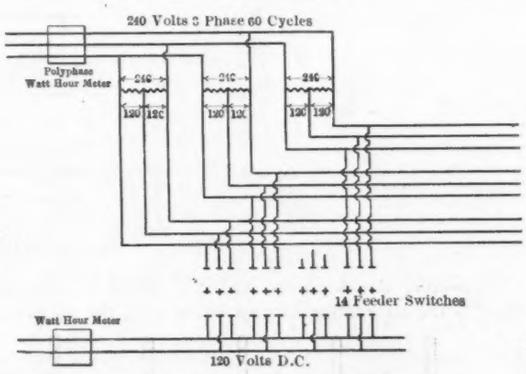


FIG. 2.—DIAGRAM OF CIRCUITS ON LIGHTING PANELS.

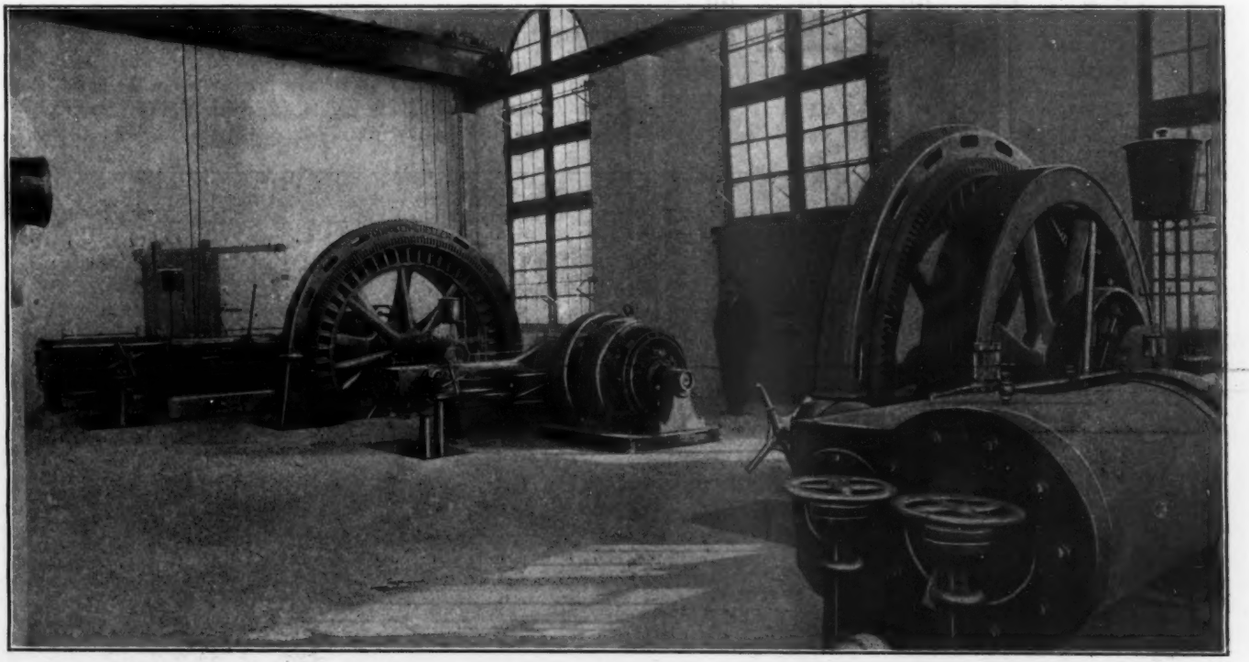


FIG. 3.—GENERATOR ROOM OF BABBITT SOAP FACTORY.

The lighting is done either from the main generators, on the

three-wire system, using a single-coil transformer across each phase, or from the 50-kw exciter set. As the transformers give 120 volts between the outside wires and the neutral, the voltage of the exciter is reduced when it is used on the lighting circuit. The switches on the lighting panels of the switchboard are triple-pole, double-throw and are wired to connect the feeders to the alternating-current busbars on the up throw and to the direct-current busbars on the down throw. When connected to the direct-current busbars the outside wires both become positive and the neutral becomes negative. The circuits are shown in Fig. 2. The feeders are so apportioned among the phases that the system is not unbalanced.

All feeders are run in conduit. From outlet plates on the back of the switchboard, the feeders run directly into a large pull box behind the board, which extends through the west wall of the engine room into the boiler room. From this box they run along the east wall of the boiler room to another box, also placed in the wall, and extending through into the passageway that leads straight through eight of the principal buildings and the small ones connecting them. The conduits are run through this passageway suspended from the ceiling on pipe-hanger rolls, branching at the proper points, as shown in Fig. 4. One other pull box was used midway of the passage to facilitate pulling in the long cables. The feeders to the detached buildings cross the intervening spaces underground in conduit. Lead cables are used in these underground stretches.

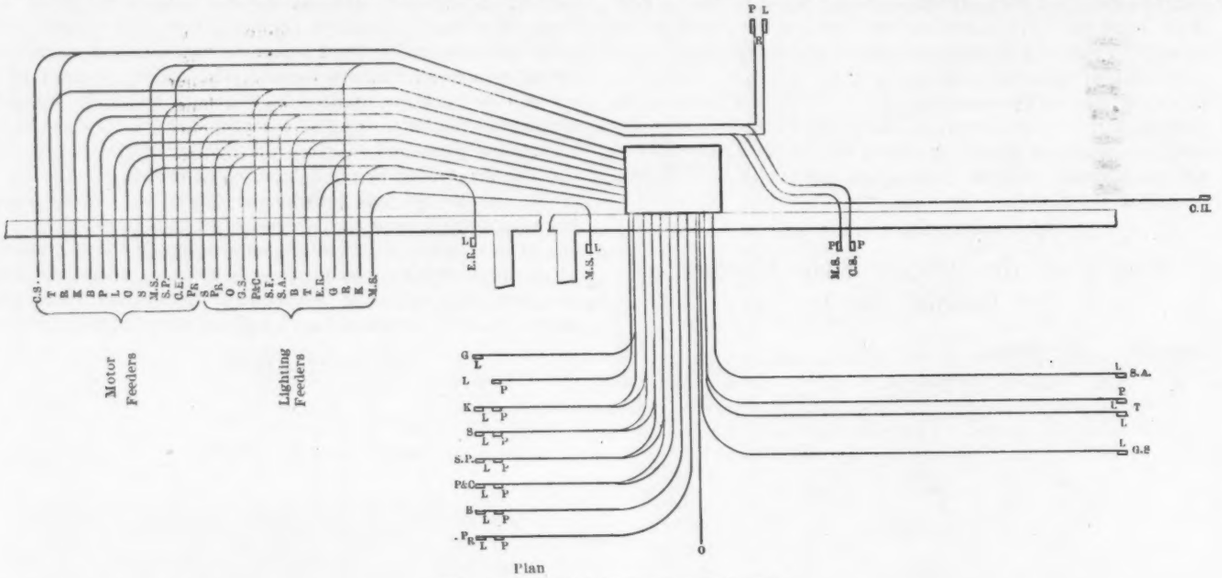


FIG. 4.—DIAGRAM OF FEEDER CIRCUITS.

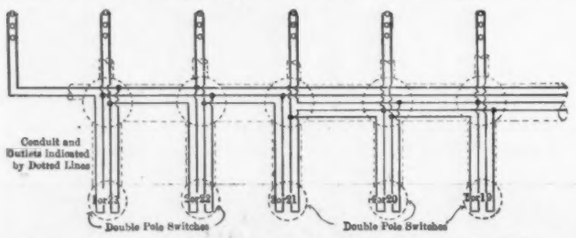


FIG. 5.—DIAGRAM OF LIGHTING CIRCUITS OVER KETTLES.

The lighting circuits are run in conduit in the power house, in all buildings where they are exposed to grease or moisture, and in all passageways. In other parts of the plant they are run on porcelain cleats on the ceilings. There is no open wiring on the walls. All circuits are run from the panel boards and switch boxes to the ceilings in conduit which terminates in condulets for open work. White lead was used in all conduit joints, and the specifications required that they should be screwed tight and made moisture-proof. All outlets are either cast-iron boxes with screwed connections or condulets.

Most of the conduit is run on the structural steel work, be-

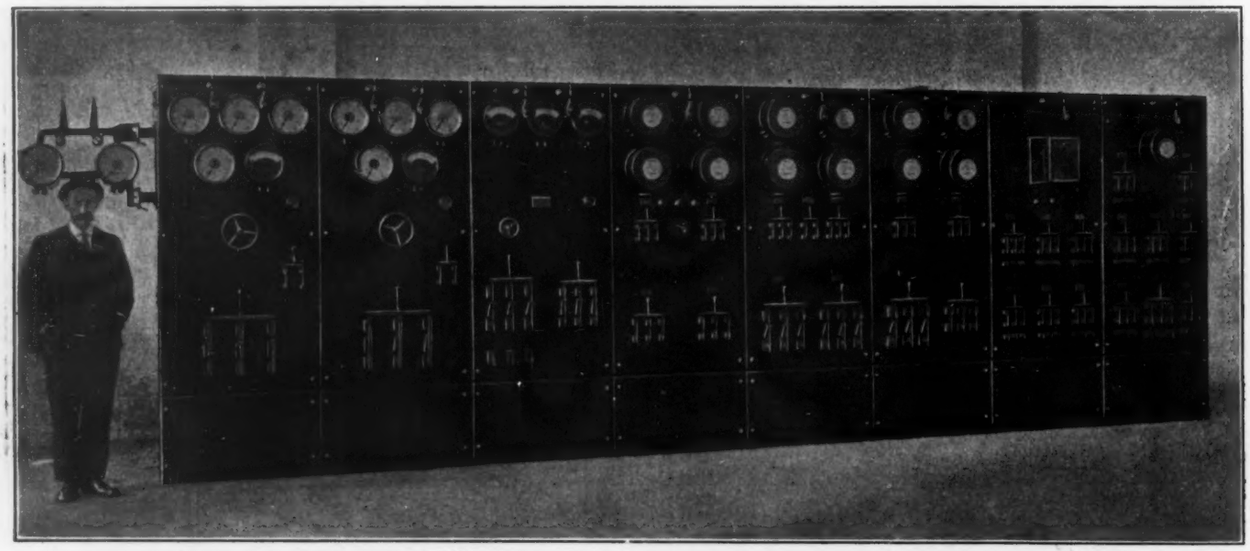


FIG. 6.—MAIN SWITCHBOARD IN BABBITT SOAP FACTORY.

ing clamped to trusses, purlins or beams. Where it is located on the ceilings and at right angles to the beams, it is run through the nailing strips instead of being bent under the beams. The exposed wires also are run through the nailing strips in porcelain tubes. This necessitated boring many hundreds of holes, which was done with an electric breast drill. The energy was supplied from the 50-kw exciter which was run for the purpose, by the contractor, as soon as it was set up.

The feeders for motors were calculated for 5 per cent drop at full load, figuring on the ultimate capacity of the departments served. Conduits were installed to receive such feeders, but when it was known that the ultimate capacity would not be reached for some time, smaller feeders were installed.

Each motor feeder terminates at a motor panel board. In many departments these panels are really small switchboards, but all are mounted on the walls in iron-lined boxes, and have the busbars and connections on the front. The panels were designed for the ultimate capacity of the departments they serve, though in some cases they are not yet fully equipped. The busbars, switches and connections were designed for the same current densities as on the main switchboard. All switches are fused with new code fuses.

The motor mains are run entirely in conduit. They lead to single motors or to groups according to the nature of the work. The motors are equipped with oil-starting switches or compensators, according to size, which are fused for both starting and running positions. A single-phase circuit of 100-amp capacity is run to the laboratory to provide for electrically heating chemical apparatus.

The lighting feeders were calculated for 3 per cent drop. In the case of the engine-room feeder this necessitated the use of resistances of 0.04 ohm, designed to carry 54 amp continuously in each of the outside wires.

For the power house and the glycerine building, which must be fully lighted at night, the neutral wires of the feeders were made double the size of the outside wires. Therefore, these buildings may be fully lighted from either source of electricity. All of the other feeders are of three equal wires. They are made safe for the use of direct current by fusing the neutral wires the same as the others at the main switchboard. It was thought desirable to make the saving in copper as, under all ordinary circumstances, there will be no need for light without motors except on a very few circuits at a time. It was considered necessary to have energy for lamps available all over the plant at all times for the watchmen.

A lighting feeder is run to each of the main buildings. In almost all cases a panel board is installed on each floor and in some of the larger buildings more than one on a floor. Where there is one above another the lower one is equipped with continuous mains, not fused, and the feeder is continued up without reduction in size.

The lighting panel boards are mounted in iron boxes. Those in the power house and the glycerine building are three-to-two-wire convertible boards, for the reasons already given. All others are simple three-wire boards. New code fuses are used on the panel boards and no fuses outside. All circuits are, therefore, limited to 12 16-cp lamps. Each board is equipped for from one to three additional circuits. The lighting mains were figured to give 2 per cent drop, as nearly as practicable.

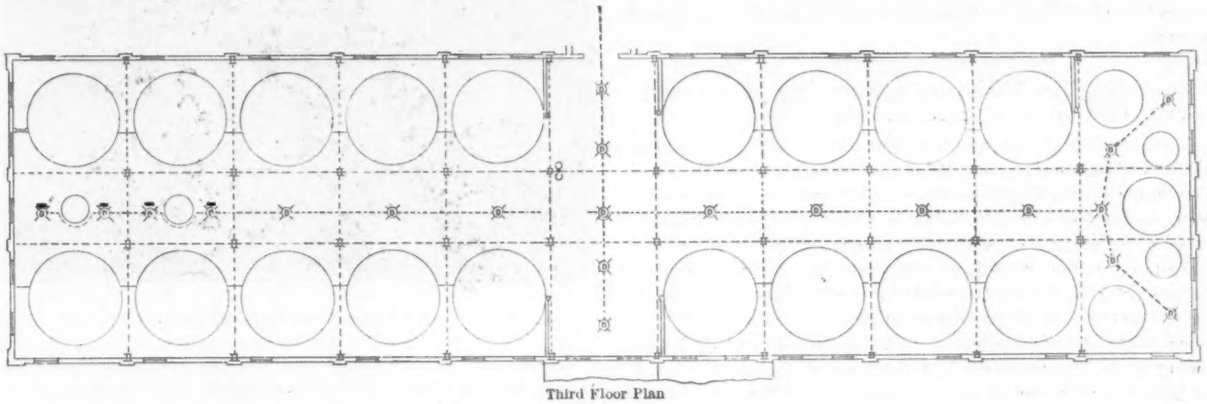


FIG. 7.—WIRING PLANS, KETTLE BUILDING.

For open-work, slow-burning weatherproof wire, white outside, was used. All drop cords are reinforced.

Incandescent lamps are used throughout the plant and these are fitted in sockets of porcelain. The amount of light required varies greatly in the different departments. The minimum, in some storage rooms, is one 16-cp lamp to 400 sq. ft. of floor space. From this the amount is graduated according to requirements to the maximum in the printing room and in laboratories and offices, where special lamps are provided in addition to those used in obtaining a good general illumination. The control of the lamps also varies somewhat. All circuits are provided with switches on the panel boards. The boxes are all locked and the keys are kept by foremen. In portions of the plant not used all of the time, such as storage rooms, snap switches are placed near the doors to control circuits or groups of lamps located to conform to the aisles in which goods are stored. Key sockets are used only in the offices and on the pendant lamps in the machine shop.

Special attention was given to the lighting of the soap kettles. These must be brightly illuminated at times, when great clouds of steam are rising from them, and they may be left dark for

long periods. To provide sufficient light, water-tight marine receptacles were placed in groups of three between the kettles and controlled by switches so connected that each kettle can be surrounded by lighted lamps independently. The circuits used are shown in Fig. 5. In addition, lamps in the aisles between the kettles provide general illumination. A circuit was also run around the room, under the windows, and plug receptacles were so placed that a portable lamp could be attached within easy reach of any kettle. All of the lamps and wiring for the room are shown in Fig. 7, which is quite typical of the circuit drawings for the whole plant.

Compartments where tallow is melted from casks are also lighted by lamps enclosed in marine fixtures. In these leather gaskets are used in place of the usual rubber ones on account of the grease. For light outside the buildings, a hooded fixture was placed over each of the many doors and on each of the telephone poles along the road leading to the railroad station.

The plans and specifications for the electrical power plant, equipment and wiring were prepared by Howard R. Barton. The entire electrical installation was put in by Messrs. Peet & Powers.

Power Station Without Operating Attendant.

That the day is not far distant when small water-powers throughout the country now undeveloped will practically all be utilized for electrical generation, can be predicted, not only on general economic grounds, but as a result of improvements in the working control of such installations which render unnecessary the presence of an operating attendant. Several plants of this character have been described in these columns, and below is given an account of another example.

The plant obtains its power from Sandy Brook, a small stream flowing from Massachusetts into the town of Colebrook, Conn., and which in a course of about 15 miles has a drop of approximately 1000 ft. Twelve dams have at various times been built at points along the stream, some of which at present are abandoned. The present plant comprises a crib-work dam 140 ft. long, formerly used by a paper mill, and which was rebuilt for its present service. A canal about ¼ mile long, with gates and racks at each end and a service tube 36 in. in diameter,

FIG. 1.—VIEW OF FALLS.

carry the water to the power house shown in the illustration, which is located over the pit of a former overshot water wheel, later replaced by a pair of vertical turbines.

The available head is 26 ft. and the present generating equipment consists of an 18-in. Rodney-Hunt horizontal turbine, belted direct to a 30-kw, 250-volt Triumph direct-current generator. The wheel is controlled by a Lombard governor.

The point of particular interest in relation to the plant is that it is started in the morning and left without attention until noon, when it is shut down for inspection and oiling, and after restarting is again left until shutting-down time. As the governor opens or shuts the gate in one second, the entire factory load carried by the plant can be thrown on and off at will with very little change in voltage. A transmission line consisting of a pair of No. 3-0 wires transmits the electrical energy to a

FIG. 2.—LOOKING UP TAIL RACE.

wood-working factory a half mile distant, where an equipment comprising the usual outfit of a complete wood-working plant with some special machinery is driven by a 30-hp, 220-volt Triumph motor. A Sturtevant engine is connected with the main shaft by a friction clutch, and, as steam is kept up for a dry kiln, the engine can be thrown into gear at any time in case of low water or excess load.

The plant described is situated at Colebrook, about seven miles from Winsted, Conn., and is owned by the Colebrook Manufacturing Company, manufacturers of wooden specialties, of which Mr. H. C. Spaulding is president and treasurer. For the information herein contained we are indebted to Mr. Spaulding, who for many years was prominent in the electrical field, having been connected for some years with the Thomson-Houston Electric Company, the Siemens & Halske Electric Company, and more recently with the Triumph Electric Company.

Grounded Secondaries.

By W. J. Canada.

THE grounding of secondaries is now advocated by practically all engineering societies, and by a majority of the electric light and power companies. From the large number of cities where all secondaries are grounded there comes nothing but praise for such an arrangement. The principal argument for this grounding is the protection of life, and particularly the life of the ordinary citizen.

Outside of the earnest advocates of grounded secondaries two prominent interests look at the matter from somewhat more complicated viewpoints. On the one side are the insurance interests, who take the stand that protection of life can hardly be made a basis for fire-insurance rate differences, which would be their only method of establishing the requirement or enforcing it. On the other hand, certain lighting companies oppose grounding on the basis of (1) greater probability of fires in connected buildings, (2) greater number of transformer breakdowns, due to this condition, and (3) the difficulties of securing effective grounds.

The insurance interests have had much reason for their stand

in the matter. The general public is only too ready to combat the improvements urged by fire insurance companies, even when losses are frequent from defective construction and figures available. But for a fire insurance company to decline writing a risk because of a life hazard would be indefensible. If it can, however, be readily shown that the condition of ungrounded secondaries may introduce a serious fire hazard, the insurance interests will be fully supported in a campaign for grounded secondaries. Their negligence to charge an additional premium to cover such a hazard would then amount to a discrimination against safely grounded circuits. Balancing such a possible fire hazard from non-grounding, however, one finds a corresponding increase in buildings having one wire grounded. The determination of the relative fire hazard of grounding and non-grounding once being made, the underwriters' argument against requiring grounding will either stand or fall.

When the great majority of lighting companies urge a general requirement for grounded secondaries, the adverse reasons advanced by the minority should be carefully scrutinized. If on examination it is found that grounding will increase the number of electrical fires, and that this argument is an opinion only of the opponents to grounding—and is refuted by the general experience of municipal authorities, lighting companies, and especially by the figures of insurance losses—it should be concluded that it is entirely baseless. If in actual experience transformer breakdowns and consequent operating difficulties and costs are not increased, then another argument against grounding is dismissed.

The difficulty of obtaining suitable effective grounds might be affected considerably by various considerations, including absence of underground water-mains, moisture of soil, and cost of maintenance. An examination of the possible variation in these conditions throughout the country should reveal whether cities opposing grounding on this basis were peculiarly ill-fitted for such grounding by these conditions. If it were learned by such investigations that none of the given reasons was substantiated in any valid way, it could be concluded that ulterior motives were influencing this opposition to grounded secondaries and the next effort would then naturally be directed to the study of such motives and their validity, together with the causes for concealment.

In examining the underwriters' standpoint and its relation to the lack of unanimity for this movement, it must be recognized that the Federal Government has no code on its books or in force offering any electric wiring regulations whatever. This is practically the case with all of the States, and even in cities a great number are still without ordinances on the subject. Where cities have ordinances and have made provision for their enforcement, the personnel of the inspection department too frequently is politically hampered by such relations. The fire department is not authorized to regulate wiring in any way. Under these circumstances the fire hazard of defective electric wiring arrangements early developed sufficiently to force its recognition by fire insurance companies. Certain arrangements of wires were found to be generally incendiary, and fire insurance companies began the custom of charging additional premiums for such defects, or even of canceling policies in more serious cases. In the absence of effective restrictions or supervision by the authorities, the requirements of insurance companies become the general rule for wiring. The companies adopted the code formulated by the associated building societies, and considered construction in accordance therewith safe. Many complaints were made, much litigation resulted and opposition arose on all sides. This code became known as the "Underwriters' Rules," and was abused accordingly. But credit for the code is due to the insurance companies, as their consistent attitude, based on experience, first made it a working force, and it is established to-day on a sure basis, though yet unsupported by statute. Unfortunately, the rules for wiring should recognize and tend to abate the resultant life hazard. The underwriters have brought it to recognition as a standard for low fire hazard, and they feel unwilling to change the status of the code as a standard of fire safety, in an effort to enforce provisions tending only to reduction of the life hazard.

For many years it has been an axiom of underwriters that the grounding of one side only of building circuits necessarily increases the fire hazard. Actual losses from such circuits, and the much greater theoretical probability of fire, both unite in the proof. Five-hundred-volt grounded railway circuits are therefore prohibited inside of buildings. This, however, is a simple case, as the demand for 500 volts on lighting circuits would naturally be small. The difficult case is the 110-220-volt secondary and 2300-volt primary, which the progress of the art has made standard. Primaries and secondaries are ordinarily parallel on the same pole line; transformers offer one path of breakdown, contacts or breaking branches of trees another. With secondaries grounded, excessive voltage in buildings is largely avoided, but the somewhat larger probability of short-circuit remains. In case of short-circuit, however, there is a considerable spacing between wires, where only 110 volts, or, at most, 220 volts, are feeding the leak or short-circuit; but with the 2300-volt circuit on wires, this same spacing can in no way be regarded as a safe one, and the accidental contacts and injuries to the installed wiring make negligible contacts become dangerous leaks, leaks become serious short circuits, and even with wires installed in a thoroughly safe manner for 300 volts, breakdowns may occur at almost any point from the imposition of 2300 volts. In the event of a short circuit, the arc in either case must be enormously greater with the higher voltage.

In the early years of electric lighting a great part of the building circuits were fed by direct current, but the rapid increase of the alternating-current systems soon brought up this question, and many lighting companies from theoretical considerations began the grounding of the secondary systems. The 1901 edition of the Electrical Code permits, and the edition of 1903 and subsequent editions recommend, the grounding of secondaries, leaving it to inspection departments to require it if they deem it necessary. Municipal departments have often made this requirement. The average underwriter's inspector believes thoroughly in grounding as a safeguard to property as well as to life, and frequently service companies have grounded their distributions at the recommendation of underwriters' inspectors. Experience has gradually developed the greater fire hazard of ungrounded secondaries, by repetition of fires, and the time seems to be ripe for the assumption of a definite code requirement for this protection, on the ground of added fire hazard, and for charging additional insurance premiums for buildings connected to ungrounded secondaries.

The objection of the opposing electric lighting interests that the fire hazard is increased by grounding secondaries being thus refuted, it will nevertheless be necessary to examine the validity of their other adverse criticism. Correspondence with 50 cities in this country where grounded secondaries are in use has failed to elicit any note of criticism by service companies on added maintenance cost of transformers, or of public dissatisfaction with any phase of the service rendered. As these cities include large and small, old and new systems, this evidence may be considered substantial proof of feasibility from the operating standpoint. These reports also come in from all classes of territory, covering circumstances of dry soil, cost of maintenance, etc., of the same nature as in those cities combating the grounding of secondaries by such arguments. As regards the difficulty of maintaining effective grounds, this is an evasion only, wherever good systems of iron water-mains exist, as in 99 per cent of all cities of the country. The cost is not large for a well-protected ground wire, sweated into a lug and with good connection to the water-pipe. Since there is normally no current, there is no electrolytic action. In practice there has been no observation of greater sensitiveness to lightning of transformers in such systems. Proper lightning arresters will dispose of any tendency to weakness in electrical storms. If lightning arresters become somewhat less effective in higher altitudes, transformer breakdown paths become more resistant in the same proportion.

In a majority of cases where service companies oppose grounding, certain circumstances which might reasonably be

expected to give rise to such opposition are noted, even though invalid as arguments against the practicability of grounding. A large proportion of companies opposing this protective method, and giving one or all of the above reasons for their opposition, will be found to be defendants in law-suits based on negligence in not grounding secondaries. Deaths, serious injuries, fire losses, all are among the circumstances of these suits though not much noted in the daily papers. Private complainants rarely, and insurance companies who may be losers in fires still more rarely, take this course. To be sure, the proportion of convictions is not large. This, however, will hardly be considered remarkable when the mystery surrounding the origin of fires or accidents to persons is well examined. Of course, if a man is found dead in the street with a live wire lying across the body, and it is badly burned, the circumstantial evidence might be considered fairly complete. The parallel instance with fires is even more difficult to find. The absolute evidence of cause of fire is ordinarily lost by the destruction of the cause, and this is especially true in electrical fires.

But the fact remains that well-founded convictions do occur. These suits must be stubbornly contested, however, as admission of error would be followed by excessive damage awards and, in many cases, by a whole family of new suits. The uncertainty of issue, the difficulty of absolute proof and the cost of suit are all that deter many individuals and companies from bringing suit on these grounds. The service company is therefore practically restrained from an admission of the suitability and serviceability of grounded secondaries for preventing injuries to life and property. An ordinance or, better yet, a statute would in these cases bring about the desirable grounding, with no prejudice to such companies, as the laws are not retroactive. This may probably be found the most feasible course in procuring the grounding of secondaries.

Ultimately the statute will be necessary, and a Federal statute should cover this with other electrical matters, giving a legal basis to construction rules which are a real necessity and the very best our experience offers. These are now based on the sanction of custom only. Such enforcement as exists at present is by municipalities or by underwriters contested and precarious.

To develop the completeness of the argument for grounded secondaries, a few instances of fires and injuries to persons might be useful.

Among other cities of the country there is one with ungrounded secondaries in which there have occurred periodic breakdowns between primary and secondary, generally during heavy sleet-storms, and of such wide effect—due to interconnected secondaries—as to include as many as 50 fires started at one time. Some of these fires were easily extinguished, some caused very considerable losses; in one case $60,000 worth of property was consumed, and the proof destroyed by the fire. Arcing of fuses, breakdowns of fixtures and the like in adjacent buildings gave only circumstantial support to the hypothetical cause of the principal loss. The evidence was decided to be incompetent, but the doubt existing as to the cause was effectually dissipated, and subsequently a settlement was effected outside the courts.

In another city an absolutely new and perfectly standard installation had just placed fixtures when a transformer became overloaded and developed a fault. Several fixture-insulating joints were broken down and slight damage done to the building, no serious fire being communicated in this case. This city has since grounded all secondaries, and has never expressed a doubt of the benefit from every standpoint.

In an Eastern city wires were crossed during a severe storm, and 2300 volts entered several buildings, doing damage particularly in one with no insulating joints on fixtures. A hole was burned in a gas pipe and the ceiling at several outlets was somewhat burned. Prompt discovery prevented serious damage, the loss being about $100.

Fire in a small Western city was started by contact in a heavy wind-storm between the primary and secondary. The old code cords broke down and lamps exploded in a room containing an open stock of cotton-batting, starting a fire with a loss of $20,000. Firemen started to fight the fire before cutting the current off from the building, and in throwing the stream some 10 ft. to the metal ceiling, four firemen were thrown down, but without particular injury. The normal voltage was only 110 volts. The wires were then cut before the firemen again proceeded to fight the fire.

During a severe electrical storm in a city with ungrounded secondaries, a breakdown occurred in two different transformers, starting two fires, one by arcing to a gas pipe and igniting the gas—loss, $100; one by arcing to metal ceiling—no loss. The second occurrence was peculiar, as this transformer for nearly a week maintained a voltage of about 400, between receptacle terminals and the above-mentioned metal ceiling. Representations were made to the lighting company; it made the test, but delayed nearly a week before repairing the defective transformer. This city still retains its ungrounded secondaries. The lighting company is affiliated with others having outstanding suits for nearly $100,000, based on negligence in maintaining ungrounded secondaries.

In a Western city a man was severely burned about the hands and feet while touching a socket, necessitating two amputations. The transformer feeding the shops in which this man worked had proved inadequate. Another had been installed without a ground wire, though this was the practice, and the transformer proved defective.

In another city where the secondaries are grounded, a young girl held in her arms a small child who touched a defective lamp-socket. The older girl was killed; the young girl was uninjured. An examination located no permanent ground in the transformer, which had been left ungrounded.

A city requiring the grounding of secondaries had the following accident: An engineer, holding a portable lamp in one hand, touched the valve of a gasoline engine with the other. He was instantly killed. A thorough test revealed a breakdown between the primary and secondary in the service transformer. The secondary ground had been omitted. A number of deaths and injuries from similar causes can be given.

Of the many instances of injuries in basements the following is a fair example: A man entered his cellar and in handling a portable lamp was killed. Transformers were not grounded in this city and the service transformer had a complete breakdown. In another city three like accidents have occurred within the past year.

A banker entering his vault carried with him a portable lamp with a defective socket. He was picked up dead a short time afterward. The transformer was defective and the secondaries were not grounded. Damages were assessed on the service company, and there were three trials before final decision.

Bathroom accidents are perhaps the most frequent of all, some 30 deaths of this kind being reported during the year 1908. In some cases the crossing of the primary and secondary is discovered, and in others the breakdown of the transformer. These cases are avoidable by the grounding.

It should be borne in mind, however, that sockets, fixtures and wires should be removed from the possibility of contact with persons. In some of these injuries it may be remarked that the secondary will test entirely free from contact with the primary, and such accidents have occurred where the secondaries were grounded thoroughly. A town in the Central States had all the secondaries for some time effectually grounded. Nevertheless, a man standing on a hot-air register turned on a wall-socket and was instantly killed. Careful tests proved the effectiveness of the ground and developed the entire innocence of the service company. Without this grounding a suit might have resulted.

As a last instance the following coroner's report may be of interest: "I find that the deceased came to his death by reason of an electric shock received by coming in contact with an electric lamp cord containing a brass socket with incandescent lamp. Said shock was received while the deceased was standing on a damp cellar floor and manipulating said wire, which contained a current of electricity. Said current found a path

through his body to the earth. I find that the light was furnished by the ——— Company.

"The effects of the passage of an electric current of high power through the human body are exceedingly variable and uncertain. It sometimes produces instant death and again no harm whatever results. As is known, nervous shock, more or less severe, burns and a variety of nervous disorders or even death may follow.

"It is unquestionably the urgent and imperative duty of every municipality to provide for a rigorous inspection wherever electricity is used in any form, and take such action as shall abolish hazardous electrical conditions.

"I therefore recommend the passage of an ordinance to create the office of city electrician, to define the duties of such office, and to establish rules and regulations concerning electrical wiring and appliances."

In this case no connection could be proved between primary and secondary. It must be remembered that lack of such proof must necessarily be frequent, as the most numerous central-station troubles with line switches opening are because of temporary swings of primary against secondary wires or against trees, or are because of limbs falling across both primary and secondary. Yet no record is left after such a momentary cross, and the proportion of fires from this trouble is very low.

Circumstantial evidence, however, frequently leads to jury decisions adverse to lighting companies who have failed to protect their lines by grounding, and the very difficulty of other proof and the Fabian policy pursued in such cases by the lighting companies really tend to strengthen the case against them. There is, moreover, no case in which an injury to person or property from electric wiring with a grounded secondary wire has been decided as negligence of the service company.

Lighting interests which have opposed the protection of life and property by the grounding of secondaries will do well to base their opposition on defensible evidence, or better yet, to abandon their position at the earliest opportunity. If the balance of fire hazard is reasonably against non-grounded secondaries, insurance interests should also unite to secure the remedy in its most practicable form. The opposition is in the minority, but the indecision means continuance of conditions adverse to property and to public safety.

The matter should be decided by the Committee on Recodification of the Code now in session and included in the National Electrical Code as a definite requirement, and the deserved prestige of these rules be supported by underwriters, municipalities and, if necessary—as is done with successful reduction of fire waste and loss of life in other countries—by action of the Federal Government.

Energy Costs in a Small Turbo-Engine Plant.

The study of electric generating costs in small central stations operating combined steam-turbine and engine-driven apparatus is of general interest at the present time, in view of the opportunities often presented to correct tendencies toward inefficiency. The following data cover the cost of producing electricity in a station of about 1000-kw rating at normal output, for the years 1906, 1907 and 1908. The design of the plant does not favor the production of power at the highest efficiency, since the station is undergoing a process of evolution from the belted type of plant to direct-connected units, and at present both arrangements are in daily service.

The station equipment in 1906 consisted of two Babcock & Wilcox water-tube boilers, each having 54 4-in. tubes and rated at 104 hp, with 120-lb. steam pressure; one 170-hp B. & W. boiler, having 81 4-in. tubes and one 144-hp B. & W. boilers, with 144 3-in. tubes. The total capacity of the boiler plant was 678 hp, and the installation remained unchanged throughout the three years. The prime movers in the plant in 1906 consisted of one Greene cross-compound condensing engine with 12-in. x 22-in. x 36-in. cylinders, rated at 175 hp and running at 100 r.p.m., and one similar engine with 16-in. x 30-in. x 48-in. cylinders, rated at 350 hp and running at 100 r.p.m. Three 150-kw belted alternators and three 44-kw Brush arc dynamos constituted the electric generating equipment. A 500-kw steam turbine was added in 1907.

Table I gives the output of the plant for the three years and the total cost of manufacture:

TABLE I.

	1906.	1907.	1908.
Kw-hours delivered at switchboard.	1,040,382	1,227,617	1,479,898
Kw-hours sold	933,401	1,013,692	1,255,196
Kw-hours sold for power	134,275	77,635	216,204
Cost of manufacturing:			
Fuel	$8,867	$11,754	$14,751
Oil and waste	270	380	389
Water	807	1,007	1,239
Wages at station	6,896	8,527	8,771
Repairs of building	46	81	130
Steam equipment repairs	904	2,069	4,837
Electric equipment repairs	41	141	257
Totals	$17,831	$23,959	$30,374

Reducing the more important of these costs to the unit basis (see Table II) gives the fuel, labor, steam-plant repairs and miscellaneous costs, with the total per kw-hour manufactured by the company. Cumberland coal and coke were used in 1906, costing, respectively, $4.29 and $3 per ton; in 1907 the coal cost $4.27 per ton and the coke $3, and in 1908 the coal cost $4.51 and the coke $2.35. In the latter year the company also burned screenings at a cost of $1.97 per ton. About 40 per cent of the fuel consumption in 1906 was coal, and in 1907 the coal burned was about 31 per cent of the total fuel used. In 1908 the coke was 17 per cent, the coal 80 per cent, and the screenings 3 per cent of the total fuel used.

The force required to handle the plant were three engineers, one electrician, one dynamo-tender and two firemen, a total of seven men for each of the years covered.

TABLE II.

	Cost in cents per kw-hour manufactured.		
	1906.	1907.	1908.
Fuel	.85	.96	.995
Wages	.66	.695	.595
Steam plant repairs	*	.168	.327
Miscellaneous	.205	.127	.133
Totals	1.715	1.950	2.050

*Included for 1906 under miscellaneous.

These figures show that the cost of operation is increasing seriously in this station from year to year, the total being 70 per cent greater in 1908 than in 1906, and on a 42 per cent increase of output. The cost per kw-hour manufactured is rising, from 1.715 cents in 1906 to 2.05 cents in 1908, or a gain in the unit expense of about 20 per cent. Without making a thorough examination of the plant it is difficult to point out the remedy, but the causes of the increase in cost may in a general way be ascertained. In the three years, with a fixed number of men handling the plant, the wages cost rose from $6,896 to $8,771, but the station output increased enough to offset this; the labor cost actually dropped from 0.66 cent to 0.595 cent, so that little objection to this part of the expense can reasonably be made. The figures show that even in a plant running toward higher operating expenses the wages need not be reduced to cut the whole unit cost, but that a raise in wages may be accompanied by increasing efficiency in the labor charge.

Fuel cost rose from $8,867 to $14,751 between the 1906 and 1908, or from 0.85 cent to 0.995 cent per kw-hour, a matter that needs close investigation at the plant. The entire process of manufacture from the delivery of the coal through to the bus-bar should be examined at the station. The cost of coal rose 22 cents per ton in three years, but this would increase the fuel expense by only about $300; in fact, the reduction in the cost of coke would offset this to an extent of 65 cents per ton. The station cannot, therefore, plead the excuse of higher coal cost. The efficiency and accuracy of all the apparatus from the meters to the coal scales needs investigation. Finally, the old equipments and its methods of handling should be subjected to expert examination to determine the cause of its poor economy and find the reason for the excessive repairs of steam equipment. If the water rate of the relatively new turbine and the evaporative powers of the boilers have not lately been tested, the time is at hand when this should be done.

Line Poles Purchased in 1907.

The U. S. Bureau of Census has compiled in co-operation with the U. S. Forest Service a report on line poles purchased in 1907, which is issued by the latter as publication No. 9 of "Forest Products." It is stated that the figures include the purchases of practically every company that bought poles during the year.

The total purchases of poles in 1907 were less than in 1906 by 66,668. There was, however, an increase of $758,471 in the total cost of all kinds of poles. The average cost per pole showed an increase of 27 cents. Cedar poles formed 63.3 per cent of the total number for 1907. The next in rank were the chestnut, which formed 18 per cent of the total. The highest average cost of all lengths of poles used for all purposes is shown for cypress, $5.17 per pole. Most of these poles were bought by the electric railway and electric light and power companies. Tamarack, which is shown separately this year for the first time, had the lowest reported cost, 74 cents per pole. Most of these tamarack poles were purchased by the telephone and telegraph companies.

In 1907 the telephone and telegraph companies purchased 2,311,651 poles, or 65.9 per cent of the total. This was 84,071 poles less than in 1906. The electric railway and electric light and power companies bought 901,559 poles, or 25.7 per cent of the total. The purchases of these companies decreased by 23,117 poles. On the other hand, the purchases of the steam railroad companies in 1907 increased by 40,520 over those in 1906. In 1907 the highest average cost is shown for the poles purchased by the electric railway and electric light and power companies, $6.02. Although the number of poles purchased by these companies was far below the number purchased by the telephone and telegraph companies, the high average cost caused the total cost of the purchases of the former to constitute over half the total cost of all poles purchased. Following are tables of data applying to the purchases of electrical companies:

TELEPHONE AND TELEGRAPH COMPANIES.

	1907. Number	1907. Cost at Point of Purchase	1907. Average Cost per Pole	1906. Number	1906. Cost at Point of Purchase	1906. Average Cost per Pole
Cedar	1,629,679	$2,956,290	$1.81	1,532,906	$3,079,852	$2.01
Chestnut	404,128	766,072	1.90	661,898	1,510,484	2.28
Cypress	22,981	24,647	1.07	21,395	36,559	1.71
Pine	48,063	47,497	0.99	121,609	478,427	3.93
Oak	66,422	23,100	0.35	2,980	1,500	0.50
Juniper	18,462	30,457	1.65	38,331	91,854	2.40
Redwood	8,052	15,313	1.90	7,140	24,390	3.42
Fir	6,691	3,964	0.59	9	94	10.44
Tamarack*	12,827	6,615	0.52	....	....	....
All other	94,346	103,064	1.09	9,454	11,789	1.25
Total	2,311,651	$3,977,019	$1.72	2,395,722	$5,234,949	$2.19

ELECTRIC RAILWAY AND ELECTRIC LIGHT AND POWER COMPANIES.

	1907. Number	1907. Cost at Point of Purchase	1907. Average Cost per Pole	1906. Number	1906. Cost at Point of Purchase	1906. Average Cost per Pole
Cedar	459,178	$3,276,980	$7.14	497,014	$2,128,793	$4.28
Chestnut	187,077	762,626	4.08	263,035	975,505	3.71
Cypress	183,501	1,066,916	5.81	78,286	200,120	2.56
Pine	26,969	134,748	5.00	39,374	185,510	4.71
Oak	2,347	4,715	2.01	4,208	9,902	2.35
Juniper	19,008	77,493	4.06	18,268	70,945	3.88
Redwood	6,586	37,852	5.75	7,749	40,879	5.28
Fir	3,408	9,284	2.72	8,308	19,010	2.29
Tamarack*	1,057	3,632	3.44	....	....	....
All other	12,338	49,601	4.02	8,434	19,731	2.34
Total	901,559	$5,423,847	$6.02	924,676	$3,650,395	$3.95

*Not separately reported in 1906.

Nearly 30 per cent of the poles purchased in 1907 were between 25 ft. and 30 ft. long, while 2,670,810, or 76.1 per cent, were under 35 ft. The timber of greatest average length was the cypress. Of these poles, over 60 per cent was between 40 ft. and 45 ft. long. The shortest were the oak, nearly 60 per cent of which was under 20 ft. long. These short oak poles had the very low average cost of 33 cents, mostly due to their use by the lesser companies in localities where small oak is the cheap timber.

While a great number of the poles consumed are used for the construction of new lines, fully two-thirds are used for renewals. Decay is the great cause of destruction of poles. It is estimated that approximately 95 per cent are destroyed by this cause, and only 5 per cent by breakage or mechanical abrasion. The average life of untreated poles of all species is estimated at 13 years. This may be much prolonged by preservative treatment, the best known of which is the creosote process. The most complete figures available on the effect of this treatment are those furnished by the German Postal and Telegraph Department, which, on the basis of 52 years of observation, give creosoted Baltic poles a life of twenty-one years.

No figures are available for the number of poles treated annually in the United States. The reports from the consumers for 1907 show that at least 396,199 poles, or over 11 per cent of the total number purchased, received some preservative treatment. Of this number, 106,781 were purchased already treated, while the balance, or 289,418, were treated with some preservative after purchase. Telephone and telegraph companies bought 47,272 treated poles, and in addition treated 183,376, making a total of 230,648, or 10 per cent of the total number purchased by these companies. Steam railroad companies purchased 37,869 treated poles, and applied treatment to 43,460 more, making a total of 81,329, or 27.6 per cent of the total number purchased. The electric railway and electric light and power companies purchased 21,640 treated poles and treated 62,582 after purchase, making a total of 84,222, or 9.3 per cent of the total number purchased.

German Central-Station Statistics and the Proposed Taxation of Electrical Service.

As has been previously reported in these columns, Germany has decided to follow the example of Italy and tax electrical service in various forms, and a measure for this purpose is now before the Reichstag. Italy has taxed electric lighting and power installations for the past 10 years. The government offers as an excuse for its proposed system of taxation the fact that the industry to be thus burdened is rapidly growing and on account of its prosperity is able to carry a moderate tax which will give a greater income from year to year.

The growth of German electrical generating stations is indicated by the following figures:

	1895.	1905.
Number of stations	375	1,530
Capacity, kilowatts	46,000	859,000
Service connected, kilowatts	47,000	1,101,000

The cost of generation in very small stations has decreased. There are cases where the entire charges, including repairs, interest and depreciation, have been only 1.4 cents with steam engines, 1.3 cents with steam turbines, and 1.1 cents with gas engines.

These figures are among the grounds for the Government's claim that no industry is better able to bear a tax, particularly as it is likely that future improvements will cost even less than at the time taxation is introduced. In 1903 and 1906 the items entering into the generation of a kw-hour, such as fuel, lubricants, salaries and wages, were in the various cities mentioned below as follows:

	1903, cents.	1906, cents.	Decrease, per cent.
Aachen or Aix	1.55	1.25	19
Barmen	2.37	1.85	23
Cologne	1.0	.95	9
Düsseldorf	1.55	1.4	10
Elberfeld	1.15	1.0	10
Hanover	2.2	2.1	5

The Government has directed attention to the great difference between the generating cost and the selling price of German central stations. In the year 1903 the direct operating costs per kw-hour averaged as follows in stations of the sizes given:

	Cents.	
Over 5000 kw	2.5	(Group I)
From 2000 to 5000 kw	3.0	(Group II)
From 1000 to 2000 kw	3.25	(Group III)
From 500 to 1000 kw	3.5	(Group IV)
From 250 to 500 kw	3.75	(Group V)
From 100 to 250 kw	4.0	(Group VI)
Under 100 kw	5.0	(Group VII)

There are, however, some stations where the costs per kw-hour are materially below 2.5 cents, and others where they are materially above 5 cents. Among the lowest stations are that

at Aachen, 1.93 cents; Berlin, 1.52 cents; Breslau, 1.93 cents; Cassel, 2.23 cents; Charlottenburg, 1.53 cents; Düsseldorf, 1.57 cents; Essen, 1.32 cents; Frankfort-on-Main, 1.55 cents; Upper-Schleswig, 1.12 cents. Among the higher costs are Achern, 6.04 cents; Blankenese, 6.22 cents; Dantzic, 6.52 cents; Carlsruhe, 5.25 cents; Liegnitz, 5.87 cents; Wurms, 8.12 cents; Stettin, 5.16 cents.

The income per kw-hour sold was as follows:

Group.	Number of stations.	Cents per kw-hour.	Percentage of original investment.
I	14	5.6	17.3
II	10	7.42	19.6
III	19	7.25	14.8
IV	23	7.5	16.1
V	15	9.15	13.0
VI	10	10.0	12.8
I	7	9.27	8.6

The charge for lighting current in 1906 by 1005 power stations was divided as follows: Forty-one charged over 15 cents per kw-hour, 359 between 12.75 cents and 15 cents, 477 between 10.25 cents and 12.5 cents, 128 10 cents or less. From this it will be seen that the average price for lighting current is between 10.25 cents and 15 cents per kw-hour in about 84 per cent of the stations.

Energy for power purposes is sold by 997 stations as follows: One hundred and thirty-two charged over 10 cents per kw-hour, 36 between 7.75 cents and 10 cents, 113 between 6.5 cents and 7.5 cents, 276 between 5.25 cents and 6.25 cents, and 404 between 4 cents and 5 cents. These figures show that the average price for power purposes is between 4 cents and 6.25 cents per kw-hour in 68 per cent of the power stations.

An example of a profitable power plant is the Berlin Electricity Works, which pays the city annually about $1,250,000, in spite of which its dividends are 10 per cent to 11 per cent. In the fiscal year from June 1, 1906, to June 1, 1907, this company furnished 143,000,000 kw-hours at an average selling price of 3.97 cents at a direct operating cost of 1.47 cents per kw-hour. The city of Berlin therefore received 10.75 cents per kw-hour. The energy sold by the company was distributed as follows:

	Kw-hour.
Private lighting	28,500,000
Public lighting	3,400,000
Factories	48,900,000
Storage batteries	5,100,000
Street railways	56,200,000
Company use	3,800,000

The following table, covering the profits of power stations in 1906, is also of interest, as percentages of the original investment:

	According to the Central Station Society.				According to Dettmar.	
Size of station. kilowatts.	Number.	Maximum per cent.	Minimum per cent.	Average per cent.	Number.	Average per cent.
50 to 100	10	8.55	1.82	5.68	18	7.1
100 to 250	11	14.82	1.60	7.36	73	9.2
250 to 500	17	13.04	4.15	8.40	20	11.7
500 to 1000	29	13.60	3.14	8.50	..	..
1000 to 2000	25	14.84	5.02	8.96	..	..
2000 to 5000	17	19.26	5.65	9.53	..	..
Over 5000	14	14.83	5.41	9.59	..	..
	123		Average	8.5	111	9.3

In 1905, 283 municipal power stations in Prussia furnished 139,000,000 kw-hours and had a surplus over operating expenses alone of $4,575,000. The investment was $31,125,000, and if interest, depreciation, sinking fund and renewals are placed at 10 per cent of this sum, the net profit was about $1,475,000, or 1.05 cents per kw-hour, and with a difference between the generating and selling cost of 3.22 cents per kw-hour.

In the fiscal year 1906-1907, 57 stock companies paid an average dividend of 5.1 per cent. In 1904, 38 of the larger municipal power stations furnished 133,000,000 kw-hours and had a surplus of $2,150,000 and a gross income of $7,800,000. According to this, a charge of 5.87 cents means a surplus of 1.62 cents per kw-hour.

Taxation is proposed as follows: For electrical energy sold, there shall be a charge of 5 per cent of the selling price, provided that this taxation does not exceed 1 cent per kw-hour. For electrical power generated only for the owner's consumption there shall be charged 0.1 cent per kw-hour. In certain cases where the energy cost is very high, a reduction of 5 per cent will be made. The only plants that will not have to pay taxation are those of less than 1.5-kw capacity. Taxes are to be paid for electrical energy by the manufacturer, not by the user. The consumer can, however, be made to pay the increase.

It is also proposed to tax electric lamps as follows:

Incandescent lamps, from 1 to 15 watts	1.25 cents each
Incandescent lamps, from 15 to 25 watts	2.50 cents each
Incandescent lamps, from 25 to 60 watts	5.00 cents each
Incandescent lamps, from 60 to 100 watts	6.25 cents each
Incandescent lamps, over 100 watts	12.50 cents each

For arc lamp carbons, 25 cents per pound. For mercury-vapor and similar lamps, 25 cents for capacity up to 100 watts and 25 cents additional for each increase over full hundreds. To carry out the lamp taxation effectively, the law will specify that cases of certain size must contain only a given number of lamps, and, the cases will receive a revenue stamp or seal.

The income the Government expects to get will be made up as follows:

(A) For energy sold: 700,000,000 kw-hour, at 1 cent, and 300,000,000 kw-hour, at 0.5 cent, giving a total of $850,000.
(B) For energy used by the manufacturer only: 2,000,000,000 kw-hour, at 0.1 cent, and 3,000,000,000 kw-hour, at 0.5 cent, or a total of $3,500,000.
(C) Lighting material, aside from mercury-vapor lamps, etc.: 30,000,000 incandescent lamps, at an average of 5 cents each, or $1,500,000, and 7,000,000 lb. of carbons, at 25 cents each. or $1,750,000, aside from the mercury-vapor lamps, etc. The tax would amount to $7,500,000, of which 500,000 would be required for administration.

This proposition on the part of the Government is naturally opposed by the electrical interests, which claim that the Government has made serious errors in its estimate and the technical societies have denounced the proposed tax as a punishment of progress.

It is also pointed out to the Government that of the $7,500,000 income, $1,000,000 will come from Government or municipal stations, $250,000 would be lost on account of the decreased taxation value of certain factories, so that in the end, after all such reductions are made and the administration cost is deducted, not more than about $3,500,000 would be left to the Government as net revenue. It is also said that the effort would not be worth the trouble, and it has been suggested by various engineers that instead a tax should be placed on coal, which could be easily controlled.

This matter of taxing electrical energy is, of course, of great interest to the electric railways. At the last street railway congress in Munich, O. Petri, taking as an example 88 railways operating their own stations, 72 of which bought energy, submitted two tables as follows:

A.—HOME POWER.

	Maximum, per cent.	Minimum, per cent.	Average, per cent.
Traction cost in percentage of operating expense	31.8	12.9	19.6
Power cost, cents	1.9	5.25	1.05
Cost of energy, cents	3.0	1.0	1.7

B.—PURCHASED POWER.

Traction cost in percentage of operating expense	40.8	10.1	27.7
Power cost, cents	4.7	1.05	1.82
Cost of energy, cents	4.25	1.6	2.92

To compare these tables properly, there should be added to Table A 0.5 cent for interest and depreciation, thus making the absolute costs of energy average 2.2 cents per kw-hour, as against 2.92 cents per kw-hour for home energy. The average cost of power for all of the railways is therefore 2.45 cents, corresponding to 3.34 per cent of the investment. Mr. Petri showed that a reduction in energy cost from 2.45 cents to 1.5 cents per kw-hour would increase railway dividends 2 per cent and if energy could be reduced to 0.75 cent per kw-hour, as in the case of hydro-electric transmission, the dividends would increase to 2.3 per cent. From this, it will be realized, of course, that the railway company would not only have to pay more for energy on account of the tax, but could not make up for it because the fare would be the same as before.

Should the taxation on coal be made on the same basis as that on energy it would result in an income of $12,500,000. The electrical industries use only one-fifth of all the coal consumed in Germany.

Comparative Energy Costs in Two Central Stations.

In the comparison of central-station energy costs the idea is widely held that the larger of two similar plants may be expected to show a better cost record per kw-hour of output. That the size of plant is less influential in determining the cost of unit operation than many other factors becomes apparent from a study of the following figures of production expense for two central stations located within 50 miles of each other, designed along similar lines, with the same type of engines; with water-tube boilers, and serving manufacturing and residential customers. In each case the company operates the local street lighting system. The figures cover the four years ending June 30, 1908, and for convenience the plants are designated as Stations A and B.

Table I gives the energy delivered at the switchboard, the energy sold for industrial purposes, and the normal rating of the plants in engine horse-power for each year.

These figures show that a rough comparative equipment rating of a little over 2 to 1 was maintained throughout the four years; that the generated output of the smaller station increased more rapidly, relatively to that of the larger station; that both stations maintained the same rating of equipment for the first two years, and approximately doubled their rating by the last year. During the four years the energy generated by plant A increased by about 31 per cent, and B by 67 per cent. Between 1905 and 1908 in Station A the sales for motors increased by 104 per cent and by 230 per cent in plant B. The ratio of energy sales for motors to generated output increased from 22 per cent in plant A in 1905 to 33 per cent in 1908. In Station B the ratio was 30 per cent in 1905 and about 58 per cent in 1908. The growth of business and particularly the development of the motor load were therefore more favorable to economy of operation, other things being equal, in the smaller plant. Figures to be quoted later emphasize that this is not without influence in the efficient production of energy at the central-station busbars.

TABLE I.

	1905.		1906.		1907.		1908.	
	Plant A.	Plant B.	Plant A.	Plant B.	Plant A.	Plant B.	Plant A.	Plant B.
Kw-hours at switchboard	4,601,230	1,916,145	5,560,328	2,835,687	5,952,956	3,240,618	6,043,204	3,288,623
Industrial kw-hours	1,009,587	574,468	1,688,545	1,185,417	2,068,436	1,610,791	2,045,145	1,894,874
Engine hp	3,750	1,500	3,750	1,500	3,750	3,000	6,750	3,000

The equipment of Station A for the years 1905 to 1907 inclusive consisted of the following principal elements:

Four 400-hp Babcock & Wilcox unit boilers, steam pressure 160 lb.; two 750-hp McIntosh & Seymour vertical cross-compound condensing engines; one 2250-hp McIntosh & Seymour engine of similar type; two 600-kw and one 1500-kw General Electric alternators; and two 125-kw, 500-volt direct-current generators, driven by a direct-connected alternating-current motor.

In 1907 two more boilers were added, the units being duplicates of the previous installation. These were also operating in 1908, giving a total steam generating rating of 2400 boiler horse-power. In 1908 the company began to operate a new 3000-hp McIntosh & Seymour cross-compound vertical engine, directly connected to a 2000-kw alternator. This unit brought the total engine rating to 6750 hp.

The equipment of Station B in 1905 and 1906 was as follows:

Three 258-hp Stirling boilers, operating at a steam pressure of 150 lb. Total boiler horse-power, 774. One 600-hp and one 900-hp McIntosh & Seymour engines; one 400-kw and one 600-kw General Electric alternators.

In 1907 two Stirling boilers were added, of the same type and rating as those previously installed, thereby bringing the total boiler rating of the station to 1290 hp. The company has also added another generating set, consisting of a 1500-hp McIntosh & Seymour engine, directly connected to a 1000-kw alternator. The total engine rating was thus raised to 3000 hp. For the year 1908 the station equipment was the same as in 1907.

Table II shows the number of men required to operate each plant for the four years covered:

TABLE II.

PLANT A.

1905.	1906.	1907.	1908.
Engineers 4	Engineers 4	Engineers 4	Engineers 4
Wipers 2	Oilers 2	Oilers 2	Oilers 3
Dynamo men.. 4	Wiper 1	Wiper 1	Wiper 1
Firemen 6	Coal passers... 2	Coal passers... 2	Coal passers... 2
	Switchb'd men 3	Switchb'd men 4	Switchb'd men 4
	Firemen 4	Firemen 6	Firemen 6
Total 16	Total 16	Total 19	Total 20

PLANT B.

1905.	1906.	1907.	1908.
Engineers 4	Engineers 4	Engineers 4	Engineers 4
Oilers 3	Oilers 3	Oilers 3	Oilers 3
Firemen 3	Firemen 3	Firemen 3	Firemen 3
			Helper 1
Total 10	Total 10	Total 10	Total 11

The generator output of plant A increased about 30 per cent in the four years; and the total number of station employees increased 25 per cent, the rated equipment of the plant increasing 80 per cent in this period. In plant B there was an increase of only 10 per cent in the number of station employees, while the output generated gained 68.5 per cent, with an increase of 100 per cent in equipment rating.

TABLE III.

Plant.	1905. A.	1905. B.	1906. A.	1906. B.	1907. A.	1907. B.	1908. A.	1908. B.
Fuel	$23,224	$15,025	$29.005	$17,918	$34,276	$23,336	$41,546	$30,046
Oil and waste	1,383	278	876	346	947	713	1,118	607
Water	2,751	589	2,681	593	3,087	818	3,281	1,255
Wages (station)	19,641	8,329	22,478	8,776	20,328	9,239	20,920	9,954
Repairs (building)	816	1,152	1,700	1,647	554	1,196	1,241	2,162
Repairs (steam)	1,863	1,254	2,131	945	1,887	893	3,558	2,680
Repairs (electric)	1,997	270	3,100	118	1,743	179	2,762	89
Total	$51,675	$26,897	$62,061	$30,342	$62,822	$36,374	$74,426	$46,794

Table III gives the cost of manufacture, omitting cents, in each plant for the four years.

Table IV shows the kind of fuel burned and the cost per ton delivered at the plant for each plant during the four years reviewed, and the fuel and total cost of manufacture per kw-hour at each station:

TABLE IV.

Plant. Kind of fuel.	1905. A. Soft coal.	1905. B. Soft coal, coke.	1906. A. Soft coal.	1906. B. Soft coal, coke.	1907. A. Soft coal.	1907. B. Soft coal, coke.	1908. A. Soft coal.	1908. B. Soft coal, coke.
Cost per ton	....	$3.49	....	$4.23	....	$4.50	....	$4.84
Cost per ton	$3.35	4.80	$3.66	4.48	$4.00	4.48	$4.40	4.44
MANUFACTURING COST PER KW-HOURS IN CENTS.								
Fuel	.505	.783	.520	.632	.575	.720	.688	.910
Labor	.425	.435	.404	.310	.341	.285	.346	.302
	.190	.182	.196	.128	.134	.115	.196	.208
Total	1.120	1.400	1.120	1.070	1.050	1.420	1.230	1.420

These figures show that the cost of coal for the stations increased steadily during the four years in each plant; that in one year the smaller plant generated electricity more cheaply than did the larger station, and in the other years there was a difference of only 0.2 cent in favor of the larger station on the average. The best record was made in 1907 by the A plant, the cost then being 1.05 cents total, per kw-hour, manufactured. Plant A's cost was the same per kw-hour in 1905 and 1906, although the principal items varied somewhat. The

total cost of manufacture increased from $51,675 to $62,061, and the cost of coal rose from $3.35 to $3.66 per ton. The kw-hour output increased 12.1 per cent. The wages cost increased about $3,000. The miscellaneous costs were practically the same. The labor costs decreased about as much per kw-hour as the fuel costs increased. Continued output increased the efficiency of the labor per kw-hour, in 1907, the cost being 0.341 cent, in spite of an increase in the number of employees at the station. Fuel cost increased to 0.575 cent per kw-hour. The miscellaneous costs decreased, bringing the total costs down to 1.05 cents, although the coal cost increased 34 cents per ton. In 1907 plant A sustained another rise of coal cost, from $4 to $4.40 per ton. The labor cost was 0.346 cent per kw-hour. The coal cost rose to 0.688 cent, with a total cost of 1.23 cents per kw-hour.

Plant B produced electricity at a manufacturing cost of 1.4 cents per kw-hour in 1905, and at 1.07 cents in 1906. There was a reduction in fuel, labor and miscellaneous costs per kw-hour. An increase of about 50 per cent in output was largely responsible for the reduction in total cost per kw-hour. In 1907 the cost of fuel increased, and the output did not grow sufficiently to offset it, so the total cost of manufacture per unit rose from 1.07 cents to 1.12 cents. In 1908 the total cost of manufacture increased from about $36,000 in 1907 to about $47,000, the total cost per kw-hour rising from 1.12 to 1.42 cents. The principal increase in cost in 1908 was due to a heavy rise in the price of coal from $4.50 to $4.84 per ton. The output remained substantially the same in 1908 as in 1907, and the fuel cost per kw-hour rose from 0.720 to 0.910 cent, an increase of 26.4 per cent.

As a whole, the figures show that in some instances the small plant may produce electricity more economically than a larger one, although handicapped by a considerably higher price of coal. Careful fostering of the motor load during non-peak hours will do much to lessen the cost of producing each kw-hour.

Low-Grade Fuels and the Power Plant.

By C. M. Ripley.

CHEAP steam is the foundation of power-plant economy. A great amount of attention has been paid to gaining a small percentage in the economy of engines or pumps, though this does not warrant as much attention as does the question of cheapening the cost of the steam. This fact is illustrated by the following figures:

Assuming that 70 per cent of the value of the fuel has been used in changing the water in the boilers into steam at 80 lb. to 125 lb. pressure, the next point to consider is what percentage of this steam energy may be used on the engines and pumps and other power-producing apparatus. A simple high-speed engine requires 35 lb. to 45 lb. steam per hp-hour under usual load conditions, a compound high-speed engine from 22 lb. to 26 lb., simple pumps from 150 lb. to 250 lb. and compound pumps 75 lb. to 100 lb. per hp-hour. As an engine or pump or other mechanical horse-power is equal to 2545 heat units per hour, and the production of a pound of steam under usual working conditions of feed water and pressure requires approximately 1000 heat units, the foregoing figures of steam per hp-hour show that with the compound engine about 10 per cent of the steam energy is used, with the simple engine about 6½ per cent and with the simple pump about 1½ per cent; or, reducing these percentages to the original basis of the heat in the coal, allowing for the 30 per cent lost, the compound engine actually utilizes about 7 per cent, the simple engine 4½ per cent and the simple pump 1 per cent; or, putting it yet another way, from 93 per cent to 99 per cent of the energy in the coal is wasted.

Considering these figures, it will be seen that doubling the efficiency of a simple pump would decrease the loss only from 99 per cent to 98 per cent, while doubling the efficiency of a dollar's worth of coal would decrease the fuel bill by 50 per cent. Furthermore, the increased efficiency of engines or pumps would be a real saving only where exhaust steam is more than enough for heating and other low-temperature uses, while the saving from cheaper fuel would be a direct benefit at all times under all conditions.

The writer has known plants with compound engines where the cost per kw-hour was greater than in a plant of similar size equipped with simple engines, owing to the high cost of steam in the former.

Relative Values of Steam Fuels.

Bituminous coal has a much larger percentage of volatile matter than any other fuel in common use to-day. As a general rule, a great deal of this volatile matter escapes up the chimney before perfect combustion takes place, thus losing much of the hydro-carbons, which are from 20 per cent to 40 per cent of the weight of the coal. It is for this reason that it is difficult to get over 60 per cent or 65 per cent boiler efficiency ordinarily with this fuel. Anthracite coal, however, gives a greater proportion of its heat (70 per cent to 80 per cent) to the boiler. This follows from the fact that the volatile matter in anthracite is from one-tenth to one-quarter that contained in bituminous coal. The fixed carbon in the anthracite has small tendency to disappear up the stack, since it remains on the grates until perfectly consumed.

The above comparison is made on the assumption that both boilers are carefully fired, although there is a greater possible loss from the poor firing of anthracite than is the case with bituminous.

Use of Coke Screenings.

Coke, with its very high percentage of fixed carbon and its low percentage of voltatile matter, lends itself well (everything else being equal) to a high boiler efficiency. Since coke screenings cost only a little more than half as much as a No. 1 buckwheat and but little more than a third as much as the larger size anthracite, we can see great possibilities of economy, provided the heat units are not reduced in the same ratio as the difference in prices. And right here is a very interesting fact—coke screenings have about 12,000 b.t.u. per pound and buckwheat and pea coal also have about 12,000 b.t.u. per pound. These considerations lead to the following conclusion with regard to coke as a fuel:

1. Greater boiler efficiency, due to less gas content. 2. Economy, due to lower price on the basis of heat units. 3. Less expense in each handling and cleaning of fires. 4. Less chance of sooty tubes and flues, owing to low per cent of volatile hydrocarbons which make most of the soot.

It should be noted also here that the gas companies must avoid the presence of sulphur in gas, and thus the very best quality of gas coal from West Virginia and Pennsylvania is purchased. Thus it is that coke contains but a very small percentage (much less than 1 per cent) of sulphur, although some coals run as high as 3 and even 3.9 per cent of sulphur. The detrimental effect of sulphur upon the boiler, the flue and the steel stack shows up in pitting and is very expensive to repair.

Forty years ago, according to the statement of Mr. R. C. Miller, of the National Coal & Coke Company, coke screenings were used in manufacturing establishments for the burning of firebrick and other purposes aside from the manufacture of power. About six years ago Mr. P. R. Moses, consulting engineer of New York City, became interested in the possibility of applying coke screenings to the engine rooms of the big hotels, apartment houses and office buildings, where expensive sizes such as pea coal and larger had been in use extensively.

It was not many years ago that the culm-banks around the mouths of the mines were considered to be valueless. When methods were developed for burning the smaller sizes of anthracite those persons who were farsighted enough to gain title to those unsightly old waste piles have become wealthy.

Methods of Burning Low-Grade Fuels.

With this in mind, together with the theoretical advantages of coke screenings and other low-grade fuels, it simply remained to develop a method for their use in the regular operation of a

power plant. Much of the No. 3 buckwheat coal and coke screenings necessarily is dust, and yet, strange to say, there are several plants that are burning this fuel in New York City to-day with natural draft. As a rule, the same grate surface required to burn pea coal or No. 1 and No. 2 buckwheat sizes is sufficient to burn properly coke screenings and No. 3 buckwheat, although it has proved advisable in several instances to lengthen the grates somewhat. Since the volatile hydro-carbons are almost absent in coke screenings, the danger of having too much grate surface for the boilers' heating surface is not as great as with other fuels. Moreover, a great many boiler systems have been found laid out with insufficient grate surface in order to burn properly the lower-grade fuels. They should never have less than 1-3 sq. ft. of grate area per horse-power.

The grate openings for the smaller sizes of buckwheat—i.e., ¼ in., 5/16 in. and sometimes ⅜ in.—where the draft is good, are suitable for the use of coke screenings. It has been found that, owing to the small amount of ash, the fires have to be cleaned less often, and therefore there is less loss of the fuel, due to the falling through the grates into the ashpit. In one factory building the fireman understood the fuel so well that on an inspection trip one afternoon at 5 o'clock it was stated that the fire had not been cleaned since 4 o'clock that morning.

Coke screenings should be wet down slightly before firing, but the porous nature of coke should be borne in mind while doing this, that too much moisture may not be added to the detriment of heating value. It should also be remembered that for this reason also any water sprinkled on the top of a large pile will be absorbed by the top layer and will therefore not penetrate to the interior of the pile, so the rule has been laid down that small piles be made previous to the sprinkling.

Firemen have been instructed to cover only lightly the fires, even to a less extent than is done with the smaller size of buckwheat. The manner of cleaning out the ashpit in order to save the intense heat on the grate bars should be part of the instructions to the firemen; but since the amount of ashes is so small this is a very simple matter. It is a fact proved in a dozen instances and more that the amount of ashes is really reduced 25 per cent to 50 per cent after the introduction of the fuel.

In an endeavor to introduce this fuel the owner of a plant will often state: "Our plant (or boilers, or grates, or draft, etc.) is such that no cheaper fuel than that which we are now using could possibly be burned." The inertia of such a man must first be overcome, but now that the prevention of waste and the conservation of our natural resources are getting so much attention all over the country, this is not so difficult a matter as it was several years ago.

Examples of Economy From Use of Coke Screenings.

It is impracticable to give here detailed cost reports from any of a number of plants whose owners have been progressive enough to avail themselves of such fuels, but following are brief summaries of the results attained in a factory, a loft building, a hotel, two apartment houses and a hospital:

1. A downtown factory building introduced the use of coke screenings about six months ago. The fuel bills for this period as against the same period the year before averaged 25 per cent less.

2. A large loft building containing 14 electric elevators and a heavy power load is selling electricity to its tenants at 20 per cent less than central-station rates, and these receipts pay almost the entire expense of the plant operation. Since coke screenings were introduced the fuel bill has decreased 25 per cent and the ash-removal bill has decreased 33 per cent.

3. A hotel, with refrigerating plant, four electric elevators, a kitchen and 1,200,000 cu. ft. to heat, besides other uses in the laundry, saved over $2,000 in the 1908 fuel bill, as compared with that of 1907.

4. A large apartment house, with 87 families, has burned coke screenings for about five years, ever since the building was constructed. Electricity sold to the tenants produces an income of $6,000 annually. There are eight electric elevators, refrigerating coils in each apartment, and the building is very much exposed to the cold winds along the front of the Hudson River. Coke screenings at slightly over $2 per ton of 2000 lb. are used, and the annual bill for fuel is about $7,000, running about $650 per month through the winter. The service of the house is of a very high class.

5. Another apartment of 2,000,000 cu. ft. and 50 families has only a heating plant, and the average expense for heating during October, November and January has been but $9.25 per day, using coke screenings with natural draft. This cost includes steam dryers for the tenants, hot water and also liberal heat for the highest class of apartment-house service in New York City.

6. Coke screenings have been introduced but one month at a hospital on the West Side of New York, replacing pea coal at $4.10 per ton. Instead of 9000 lb. per day of this expensive fuel, there are used only between 6000 lb. and 7000 lb. per day of coke screenings at slightly over $2 per ton.

It is the belief of the writer that the use of this fuel will add revenue to the gas companies throughout the country and will also result in great saving to the manufacturers of power, as soon as ignorant prejudice against it can be overcome.

Coal Specifications.

In a paper presented before the Illinois Fuel Conference held at Urbana, Ill., March 12, Mr. D. T. Randall, engineer of tests at the United States Geological Survey Experiment Station, Pittsburgh, discussed the various points relating to the economical use of fuel, including furnaces, draft, kinds of fuel, influence of ash, moisture, volatile matter, etc., and concluded with a draft of specifications for the purchase of coal.

The United States Government, which has, he stated, an annual fuel bill of $10,000,000, analyzes and tests much of its fuel. In a single contract for the present year of 400,000 tons of coal, the specifications required a heat value of 14,600 lb.-Fahr. heat units. In order to compare the cost of coals used by the Government in the larger cities of the country, it has been customary to calculate the cost on the basis of the number of cents per 1,000,000 heat units. It is interesting to note that for last year's contracts the cheapest coal was delivered in Louisville costing only 7.1 cents per million units. The cost in Boston for similar coal was 16.3 cents and in St. Paul the price was 17.1 cents. Anthracite coal was delivered in Eastern cities at prices ranging from 8½ cents per million heat units for buckwheat coal to 14 cents for pea coal, and as much as 20 cents in some cases for egg and broken coal.

Having decided upon a kind of coal to be used for a plant, the purchaser naturally desires to have some assurance that he may be able to secure the coal in question, or one of practically the same composition, for a given period. This has led to the use of specifications for the purchase of coal. If the size of the contract and other conditions warrant the use of a specification, then the proposal for coal to be of value should contain at least two general statements regarding the kind and character of coal.

The bidder should state in his proposal (1) the commercial name and size of the coal to be furnished. The size should be specified within certain limits in order to avoid disputes when coal is delivered. (2) The character of the coal to be furnished, in the following form:

PROXIMATE ANALYSIS.

	As received.	Dry coal.	Free from moisture and ash.
Moisture			
Volatile matter			
Fixed carbon			
Ash			
Sulphur separately determined, per cent			
Lb.-Fahr. heat units in coal as received (not dry)			

The price per ton should be stated for coal of the specified quality. The price to be paid on coal delivered should vary

directly with the heat units in the coal "as received," this value to be modified further, if advisable, by corrections, as follows: 1. For more or less ash in the dry coal. 2. For more or less volatile matter in the "combustible," allowing in all cases 2 per cent or 3 per cent variation without premium or penalty. A limiting value may be placed on the percentage of sulphur in the coal which will be accepted. Corrections for ash and volatile matter are best expressed in the form of a table. In making corrections for variations in the quality of the coal delivered, it may in some cases be more convenient to make all changes in the price on the basis of change of the heat units.

The reasons for basing contract on the items mentioned above are as follows: "The heat units in the coal as received" corrects for changes in heating value due to changes in both ash and moisture. The heat units in the coal as delivered being the most direct measure of its value to the consumer, it is reasonable that the contract should be based principally upon this value. This value may be determined and reported directly by the chemist. This results in a premium for better coal and a penalty for coal not up to the standard. As has been shown above, so far as is now known the presence of small amounts of moisture in the coal has but little effect on the efficiency of the boiler. As coals from the same mine or group of mines do not usually vary more than 3 per cent or 4 per cent in moisture, it hardly seems worth while to correct for the small amount of heat lost in evaporating it. By basing the value of coal on the b.t.u. as received (moist), the variations in heating value as otherwise affected by the moisture are provided for.

"Ash in the dry coal" is independent of changes in moisture in the coal, this figure always being the same no matter what the moisture content may be. Coal delivered from the same mines may vary considerably in the percentage of ash. A reasonable allowance, such as 1 per cent or 2 per cent from the average, would seem to be desirable, as such a variation is almost unavoidable in commercial products. Inasmuch as the heating value is taken care of by the heat-unit determinations, the only remaining correction to be made for the ash is the extra trouble in handling the coal and ashes and the possible reduction of the capacity of the equipment. When the ash greatly exceeds the amount for which the furnace was designed, the reduction in capacity may become a serious matter and would justify a rapidly increasing penalty. For the first 3 per cent or 4 per cent increase or decrease in the ash it is only necessary to provide for the difference in the cost of the handling, which is between ½ cent to 1 cent per ton for each 1 per cent of ash in the coal. If corrections other than for heat units are to be made, and the ash is a factor, the specifications should be based upon the percentage of ash in the dry coal for reasons which are explained elsewhere.

If volatile matter is to be corrected for, then "Volatile matter in 'combustible'" is preferable to "Volatile matter in coal." It should be the same, or nearly the same, regardless of variations in moisture and ash in the coal, and it is more properly a measure of the difficulty to be experienced in burning coal, as it is the direct ratio of the volatile matter to that part of the coal which is actually burned. It is reasonable to have a penalty for great variations in the volatile matter from the standard specified, for the reason that furnaces are not all equally well designed to burn coals high in volatile matter. This should not in any way affect the dealer or operator, provided the coal is furnished from the same mine, as the volatile matter should remain practically constant and a reasonable limit should be established within which no change in the price would be made. This variation could well be 3 per cent either way from the standard established. The value for volatile matter should be based on volatile matter in the "combustible" (coal free from moisture and ash), as this value remains nearly constant in the same coal. Premiums or penalties for lower or higher volatile matter may properly vary according to the existing local conditions.

Sufficient information is not available on which to base a reasonable rate for correction for sulphur in coal.

Employer's Liability—Fellow-Servant Rule.

By John Edson Brady.

In these columns has previously been discussed the liability of an employer to one in his employ who is injured through the negligence of a co-employee, taking up the fellow-servant rule, which relieves the employer from liability in such cases, and the limitation upon that rule, known as the superior-servant rule, which makes the employer liable where the negligent servant is superior in rank to the injured employee. This limitation as it exists in Illinois and other States has already been referred to. There are, however, a few other States in which the limitation has been recognized by the courts.

The superior-servant rule has been adopted in Kentucky to the extent of holding the employer legally responsible for the gross negligence of a superior employee, which results in injury to a subordinate. But the liability is limited to gross negligence. The employer is not liable in Kentucky to the subordinate for the consequences of what the law terms "ordinary negligence" on the part of a superior servant. Louisville Railroad Company vs. Collins, 2d Div., 114, was the first Kentucky case in which the superior-servant rule was applied. The facts were as follows: An engineer in the employ of the defendant railroad company started up his locomotive, while the plaintiff, who was his subordinate, was at work beneath it. The plaintiff sued the company for damages for the injuries received and obtained a verdict for $5,000. On the appeal, it was held that the engineer had been grossly negligent and the judgment was, therefore, affirmed. Judge Robertson said: "It (the company) is, therefore, responsible for the negligence or unskilfulness of its engineer, as its controlling agent in the management of its locomotives and running cars, and that responsibility is graduated by the classes of persons injured by the engineer's neglect or want of skill. As to strangers, ordinary negligence is sufficient; as to subordinate employees, associated with the engineer in conducting the cars, the negligence must be gross; but as to employees in a different department of service, unconnected with the running operations, ordinary negligence may be sufficient."

In Kentucky Distilleries & Warehouse Company vs. Schreiber, 73 S. W. Rep. 769, the plaintiff was employed in the meal-room of the defendant's distillery. Being temporarily in the mash-room, he was ordered by one who had authority over him to turn on the cold water feeding into the mash-tubs. He undertook to obey the order and mounted the trestle and removed the cover on the mash-tub just under the cold-water pipe. Just at this juncture the hot water, feeding into the mash-tub, was turned on by someone in an adjoining room. The plaintiff being close to the hot-water pipe, received the full force and effect of the scalding water. The company was held liable for the reason that it was the duty of the superior servant to acquaint the plaintiff with the peril attending the work which he had been ordered to do, and that, in failing to observe this duty, he was guilty of gross negligence. Kentucky is the only State which has adopted this particular limitation on the superior-servant rule—i.e., that to hold the employer liable for the negligence of a superior servant, resulting in injury to a subordinate, the negligence must be gross. Gross negligence is defined in Illinois Central Railroad Company vs. Elliatt, 59 S. W. Rep. 13, as a failure to use such care as careless and inattentive persons usually exercise under like circumstances.

The State of Texas also has a superior-servant rule peculiar to its own jurisdiction. There the employer is not liable for the negligence of every servant of a higher rank than that of the injured servant. He is liable only where the injured servant was under the direction and control of the superior and could be discharged by the latter. The rule may be an arbitrary one, it is admitted by Justice Pleasants, in Bering Manufacturing Company vs. Femelat, 79 S. W. Rep. 869, but it is uniformly recognized by the courts of Texas. Thus it has been held that a conductor, having superintendence and control over a brakeman, but having no authority to employ or discharge him, is

not a superior servant, for whose negligence the brakeman can recover against the company. Campbell vs. Cook, 86 Tex. 630. This doctrine does not apply where the negligence complained of is the omission of a duty owed by the master to the servant, the performance of which he has delegated to one of the employees. Such omission is the negligence of the master himself, the consequences of which he cannot avoid by the attempt to delegate his duty to one who has not discharged it.

In North Carolina the liability of the master to one servant for the negligence of a superior servant is not, as in the State of Ohio, made to depend entirely upon the relative rank of the two employees.

The test applied in that State is whether the subordinate feels constrained to obey the orders of his superior, by reason of the fact that he has just grounds for believing that a failure or refusal to obey may be followed by his discharge from the service. Under these circumstances the employer must answer for the negligence of the superior employee. The fact that the superior has authority to employ and discharge his subordinates is not, in North Carolina, alone sufficient to charge the master with liability for his negligence. Webb vs. Richmond Railway Company, 97 N. Car. 387. In Logan vs. North Carolina Railroad Company, 116 N. Car. 940, the plaintiff, a section hand in the employ of the defendant railroad company, had been injured as a result of the failure of the section boss to stop the handcar on which the plaintiff was riding in time to avoid a collision with an approaching train, and the carelessness of the section boss in directing the removal of the car from the track. The section boss had full authority to employ and discharge hands. It was held that the plaintiff and the section boss were not fellow servants; consequently the fellow-servant rule, under which the company would have been free from liability, did not apply and the plaintiff was permitted under this decision to recover damages.

On the other hand, the employer is not relieved from liability simply because the negligent servant has not been invested with the authority to employ and discharge those under his control; for, while the fact that the superior servant possesses this power may be evidence that the subordinate's fear of loss of employment is well founded, it is reasoned that to make the master's liability dependent upon the possession of this power by the negligent superior servant would afford the employer an opportunity to avoid just responsibility by placing the actual power to employ in another than the immediate superior, while the superior's recommendations of employment and discharge would always be favorably acted upon. A. & E. Encyc. of L., Vol. 12, p. 928.

In an Arkansas decision, that of Boyd vs. St. Louis Railroad Company, 58 Ark. 66, which arose before the passage of the act defining who are and who are not fellow servants, it was held that the foreman of a squad of railroad workmen, engaged in building and repairing bridges and trestles, who had power to employ and discharge the men, and to oversee and direct their work, was so far a vice-principal as to make the railroad company liable for his negligence in giving inconsistent orders to the men, resulting in an injury to one of them. The superior-servant limitation of the fellow-servant rule seems to be distinctly favored in Georgia. In Blackman vs. Thomson-Houston Electric Company, 102 Ga. 64, it was held that one who was employed in the capacity of engineer for an incorporated manufacturing company, but who was under a duty generally to obey the orders of a person placed in authority over him, having power temporarily to withdraw him from the performance of the special work for which he was employed, and to assign him to other duties, was not a fellow servant with such superior. 12 A. & E. Encyc. of L., 929.

In the work just cited it is said: "The very great confusion which has been shown to exist in the law of fellow servants in those jurisdictions where the superior-servant limitation has been adopted, and the inability of the courts of those different jurisdictions to agree upon some common principle, by which to determine the employer's liability for the negligence of a superior servant, furnishes strong evidence that these courts have, in their recognition of this anomaly in the law, radically departed from sound principle. According to the view which harmonizes best with the analogies of the law, and which furnishes the safest guide in the majority of cases, the master's liability to one servant for the negligence of another in nowise depends upon the comparative rank of the negligent servant. True, the master may be liable for the negligence of a superior servant, but it is not because of his superior rank. It is because he is charged with the performance of one of the master's personal duties. And it is immaterial whether the servant who is charged with, and fails in the performance of, the master's personal obligation ranks above or below the servant who is injured."

In most of the States the superior-servant rule is repudiated, either expressly or impliedly, and it is held that the fact that the person whose negligence caused the injury was of higher grade than the injured servant, or that the latter was subject to the direction and control of the former, and was engaged at the time of the injury in executing the orders issued by the former.

And such a situation does not prevent an application of the fellow-servant rule, under which the master is not liable to a servant who is injured through the negligence of a co-worker. Among the States which have refused to accept the superior-servant limitation may be mentioned New York, Connecticut, Indiana, Maine, Massachusetts, Minnesota, New Jersey, Pennsylvania and Wisconsin.

Suggested Patent-Law Amendments.

Mr. Isaac L. Rice in an article in the March issue of *The Forum*, discusses present abuses and imperfections of the United States patent system, and offers a number of suggestions as to changes in patent laws and in Patent Office practice. To bring the patent system to a proper footing requires, he believes, a complete change of the theory which now underlies patent law, namely, that a patent monopoly is a private privilege derogatory to the personal rights of each individual affected by it, and that therefore the right to the privilege must be established anew against every individual contesting it, by suits in personam. From this false theory, all the incongruities and iniquities of our patent law flow as logical consequences. The very contrary is true: a patent is an obligation assumed by the public for a valuable consideration which it must enforce as a public duty against all infractors; and the proceedings relating to patents should therefore be in rem. That is to say, before the public definitely assumes the obligation, it must be definitely ascertained whether the claimant is entitled to be considered an inventor and whether the public is benefited by the invention, and this once ascertained and established, the patent should be held good and valid against the world."

The paper concludes with the following suggestions for changes in the present patent system.

1. The establishment in Washington of a federal court having all the powers of a court of chancery invested with exclusive original and appellate jurisdiction throughout the United States in patent and kindred causes, whose process shall run throughout the United States and its possessions.

2. The publication of an official weekly patent gazette containing in extenso all patents granted within the preceding week and which shall be open to subscription or for sale in single numbers.

3. All grants of patents to be provisional for a period of six months and subject during such period to proceedings for annulment on part of the public.

4. All persons desiring to obtain a decree for the annulment of any patent to file severally with the clerk of the court a complaint containing the allegations claimed to constitute grounds for annulment. Such grounds should be fixed by law, well defined, and under principles easy of application, since by the publication of the invention incident to the granting of a patent the patentee loses his property therein for the benefit of

the public, and therefore annulment is tantamount to confiscation.

5. Upon the filing of any complaint, the clerk shall immediately notify the patentee by mail of such complaint and also cause to be served upon him a copy thereof. Within two months after such service the patentee shall file his answer and the clerk shall likewise cause a copy thereof to be served upon the complainant, after which service the case shall be placed upon the calendar and brought to trial within nine months after the grant upon all the complaints simultaneously. If the complaints are numerous, the court shall upon application of the patentee appoint a special master in chancery to collate and marshal the issues, and the court during trial may make such rulings as may be proper to prevent cumulative testimony. If the state of the calendar is such that the case is not likely to be reached within that time, then upon motion by any of the parties, any judge of the court may appoint a master in chancery vested with all the powers of the court for the purpose of conducting such trial.

6. At such trial the parties shall appear with their experts and witnesses, who shall be examined orally, and shall produce such testimony as may have been taken by commission under special authority of the court upon issues of fact, and the case shall be heard uninterruptedly during court hours until completed, whether the same be before a judge or before a master.

If the trial is had before a master, he shall file his report within three months after such trial, and such report shall have the effect of a final decree unless disapproved by the court within 30 days thereafter, and a new trial granted.

7. The decree may sustain the validity of the patent, may amend it so as to conform with the evidence, or may annul it. Any of the parties may appeal from the decree to the Appellate Division of the Court within 60 days after service of the entry thereof, which service shall be caused to be made upon all the parties by the clerk of the court. If upon the hearing of such appeal any judge may find it necessary to ask questions of the counsel of either party, which cannot be answered by the testimony of record, such counsel shall be entitled to subpœna further witnesses for examination before the appellate division on the points to be elucidated; and such testimony shall form part of the record as though it had been originally given in the trial of the case.

8. In the absence of any proceedings for annulment of a provisional patent for the space of six months after its grant, or upon entry of a final decree, the issue of the patent shall take place, and upon such issue it shall be held valid against the world and subject only to cancellation on the ground of subsequently discovered fraud.

9. In the event of any infringement of a patent, the patentee may bring suit against the infringer in the patent court for an injunction and an accounting, and on proper affidavits shall be entitled to a preliminary injunction restraining the infringement of the patent pendente lite, the only defense permitted in such a suit to be that of non-infringement.

10. In order to prevent a patent from ruining existing industries, persons affected may petition the court for a compulsory license, and upon the patentee being heard the court may, where the evidence sustains the petition, in its discretion, order the patentee to give the licenses prayed for, but only on terms which in the opinion of the court will afford the patentee ample remuneration and provide for amortization.

11. The duration of a patent should date from the final issue, and be limited to seven years, with the right on part of the patentee to obtain two several renewals of his patent of five years each.

12. As under the proposed legislation patent rights would become valuable property, the fees should be sufficiently high to defray at least all the expenses connected with the maintenance of the Patent Office and of the patent court. They should be so graded as to be comparatively low for the provisional grant, considerably higher for the final issue, and correspondingly increased for each renewal.

Storm and Lightning Protection to Line Wires.

By T. W. Poppe.

The recent sleet storm in New York has shown the mechanical weakness of the wires throughout the storm region. The ice gathering on the wires did but little damage; the greater damage was done by the ice accumulating on the twigs and smaller branches of a large branch of a tree and so weighting it that it broke off. In many cases it broke off close to the trunk of the tree and fell, throwing its weight upon the wires.

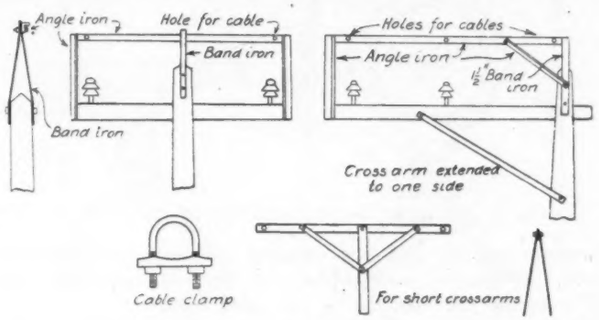


FIG. 1.—DETAILS OF CROSS-ARMS.

bearing them downward. In some instances the wires were broken. Where the voltage was sufficiently high the damp branch falling on the wires produced an equivalent to a short-circuit, causing the circuit-breakers or fuses in the power houses to disconnect the wires from circuit. In some districts where high-tension wires had been broken and repaired it was possible to supply electricity, but lack of confidence in the ability of the entire line to withstand the balance of the storm caused the managers to disconnect the entire system from use. This was in most cases a wise move, as had any wires broken and fallen to the ground in such a manner as to be in the path of pedestrians, a lawsuit against the electric light company would undoubtedly result.

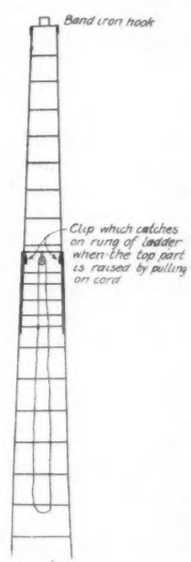


FIG. 2.—LADDER.

Had the lines been protected against such dangers the position of the affected electric light companies would have been much stronger than they are now. The gas man or company who would not use happenings of this nature to the disadvantage of the electric light company would indeed be asleep. These lines can be more cheaply protected from such dangers when the poles are being installed, and it is strange that the erecting engineer does not take precautions against any troubles of this nature. The protection of wires and electrical machinery from lighting justly engages the engineer's attention and consideration, and a danger which threatents at any time to render the machinery and lines just as useless as lightning is apt to do deserves just as much consideration.

To equip properly the pole lines now in use so as to protect them from sleet, wind and lightning is a comparatively inexpensive matter. The pole lines as now constructed need not be exchanged and the wires can remain as they are. The changing of either would be an expense in two ways: To change one would mean changing the two, and changing the wires would mean oftentimes cutting the customers out of service. This should be avoided at all times if possible. If means be taken to prevent any weight from striking the wires, part of the problem is solved. This can be done by installing a galvanized steel cable consisting of seven strands of No. 10

wire above and parallel with the electric wires. As the wires carrying the highest voltage are generally on the top cross-arm on a pole, which is about 9 in. from the top, a rigging as shown in Fig. 1 can be constructed of 2-in. angle iron. The brace from the middle of the horizontal angle iron need be only ½ in. x ½ in., band iron. The holes shown in the horizontal angle iron are for the stranded cable to be drawn through, pulled taut and fastened by using the cable clamp on each side of the angle iron.

This cable support can be fastened to the pole by boring a

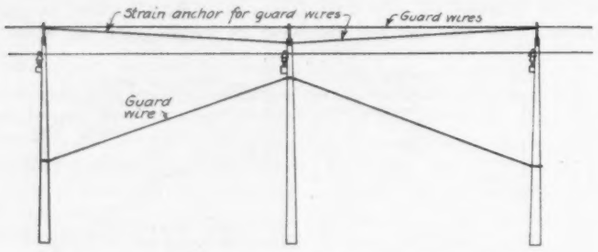


FIG. 3.—ELEVATION OF POLES SHOWING GUARD CABLES.

hole through the pole and clamping the two pieces of band iron, forming the middle brace, to the pole using one bolt. Placing the end supports of the cable supporters is a more difficult matter, as they are on the end of the cross-arm and hard to work upon to advantage or safely. However, if necessary, an extension ladder, as shown in Fig. 2, can be used. The hook shown is to rest on the cross-arm where the latter will support it, while the pin carrying the insulator will prevent it from moving from its position. In the end of the cross-arm a

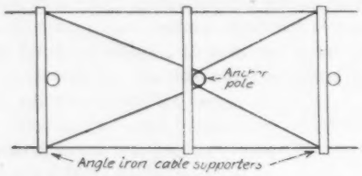


FIG. 4.—PLAN VIEW OF POLES.

¼-in. hole should be bored to a depth of 4-in. This will allow a ⅜-in. x 3½-in. lag bolt to enter without danger of splitting the arm. This lag bolt will hold the upright angle iron braces firmly. After five of these cable supporters are placed in position two cables should be fastened to the top of one pole. This will serve as an anchorage for this section of cable. The cables should then be drawn through the holes in the cable supporters. To reduce the friction caused by the cable rubbing the sides of the hole in the angle iron a compound of a consistency of jelly

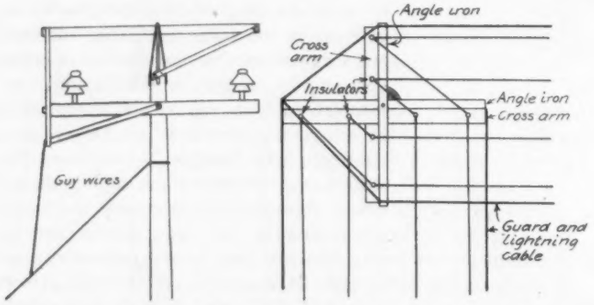


FIG. 5.—METHOD OF SUPPORTING AND ANCHORING CABLES.

should be used to lubricate it. The cables should be drawn taut and fastened to the sixth pole from the anchor pole. They can then be fastened by using the cable clamps (Fig. 1), placing one on each side of each horizontal angle iron. Tin wires should not be used, as the strength of the fastenings represent a great part of the strength of the entire section of cable and supports.

Fig. 3 shows the guard cables in position. The object of anchoring the cables every seventh pole is to allow the cable to carry any weight it might be called upon to carry without taking enough slack cable from the rest of the line to allow the cable to settle on the electric light wires. The entire line can be protected in this manner. Where the pole line changes its course and goes at right angles, Fig. 5 shows a plan of supporting and anchoring the cables and strengthening the cable supporters. The cable supporter is connected to the guy wire which sustains the pole by means of a seven-strand cable. The guy wire should also be of seven strands. Stranded wire will sustain a greater weight than solid wire of an equal diameter. There should be no strain insulators on these guy wires. The reason for this will be apparent later.

To utilize these cables in protecting against lightning is now a simple matter. At every pole used as an anchor a No. 6, or larger, copper wire should be soldered to the cables and connected to earth. Each cable supporter connected to a guy wire serves as a partial ground, hence avoiding the use of a strain insulator. A good ground connection can be secured by driving a piece of 1-in. galvanized iron pipe 15 ft. long into the ground. The wire from the cables to ground should be soldered to this pipe. The grounding of the cables at every seventh pole will give a stroke or discharge of lightning many points to dissipate itself and enter the ground. Should it be feared that the guard wires are too far apart and thus will not afford proper protection against the falling of small branches between them onto the wires, a third or fourth cable can be installed by making proper holes for them in the horizontal angle irons which form the top of the cable supporters. There is no question about the above arrangement making a good lightning arrester, as it is putting the ground above the wires. Dr. Steinmetz has said that the best lightning protection was to put the wires under the ground and if that was impossible to put the ground above the wires. This puts the ground above the wires, virtually because of its many ground connections, and is the nearest approach to the ideal conditions guarding against lightning.

A Peculiar Meter.

By F. J. Murman.

A meter installed in a residence which had been registering properly for two years, all at once seemed to behave in a peculiar manner. According to the index, the meter was recording backward, but an inspection of the installation showed

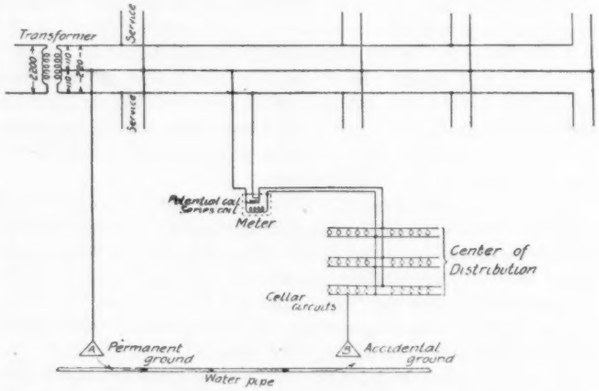


DIAGRAM OF CONNECTIONS.

that the meter was apparently connected properly, and with a 16-cp lamp burning the disk rotated in the forward direction.

The installation was two-wire, 110 volts, and was supplied from a three-wire overhead secondary system, with grounded neutral. The main switch was located on the third floor, the meter in the cellar and the center of distribution on the first floor. The distance from the main switch to the meter was

60 ft., No. 8 wire being used for mains, and the distribution circuits being of No. 14 wire.

The writer, being called into the case, found the secondary system considerably unbalanced so that the neutral wire carried considerable load. It was also found that the series coil of the meter was connected to the neutral, or grounded, leg of the three-wire secondary system and that an accidental ground was on the cellar circuit. When the installation was inspected in the daytime the system was not unbalanced, therefore, with a 16-cp lamp burning the disk rotated in the forward direction, although not at the proper speed on account of the series coil being shunted by a ground on each side of same.

At night, with the cellar lamps burning, the disk rotated in the forward direction, but very slowly, although a number of lamps were also burning in various parts of the house at the time. It was then discovered that by turning off all the cellar lamps the disk rotated in the backward direction. The case was then summed up as follows:

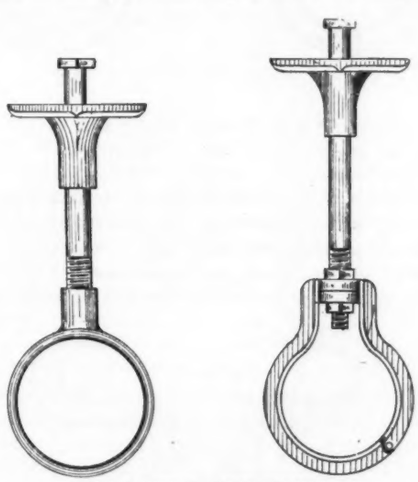
Certain changes in the secondary system resulted in transposing the service wires supplying energy to this particular installation, thus connecting the series coil of the meter to the grounded neutral. When the line *L* was loaded, due to the system being unbalanced and as the cellar lamps were not used, the ground circuit would help to supply energy to the system, and the current through the series coil of the meter would relatively reverse and cause the meter to record backward; but when the cellar lamps were burning, the cellar circuit wires, being of limited capacity, were loaded, then the circuit took the all-copper path and the meter would record in the forward direction. The trouble was corrected by clearing the accidental ground and connecting the series coil of the meter to an ungrounded leg of the system.

This incident indicates the necessity for careful inspection of installation details when making periodic tests of meters.

Pipe-Hangers.—II.

By W. H. Wakeman.

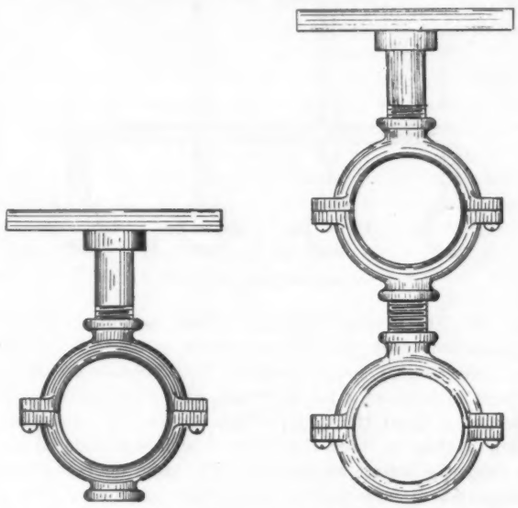
In the first issue of March a number of hangers for pipes were illustrated and described. The number of hangers was by no means exhausted, and various others are herewith shown. Fig. 1 illustrates a cast-iron hanger that is strengthened and made adjustable to a limited extent by a bolt concealed when the pipe line is finished. The ring is solid, but may be raised



FIGS. 1 AND 2.—PIPE HANGERS.

or lowered by the threads shown. Fig. 2 represents a malleable-iron hanger, with a hinged ring held in place when closed by two check nuts which can be turned without a wrench. It is a mistake to make nuts fit so closely that it becomes hard work to turn them with a small wrench, as they ought to be tapped one size larger than the bolt, for they seldom work loose in ordinary service. They should not require oil, because oil will retain dust which settles on the hangers and in due time cause them to become clogged and difficult to handle.

The type of hanger shown in Fig. 3 admits of only slight adjustment in any direction, but the ring is split horizontally and held in place by screws or bolts as required. The lower half is removed before the plate is fastened in place, thus re-



FIGS. 3 AND 4.—SINGLE AND DOUBLE PIPE HANGERS.

ducing the weight that must be carried and held by the workman in more or less inconvenient positions while locating a line of hangers. After the lag screws or bolts, according to the design adopted, are securely fastened, holding the plate against the timber, the pipe is raised into proper position and temporarily supported there, the lower half of the ring is attached as illustrated, and the work is done.

Bolts are frequently considered stronger and more reliable for such work than screws, but this is not necessarily true. If a nut is only ½ in. thick, tapped for 14 threads per inch, it holds by seven threads. If a screw is tapped into a hanger that is ½ in. thick, it holds by seven threads; hence there is no difference in this respect. As a general rule, the workmanship is better where screws are used, because holes must be bored in one-half of the hanger to be tapped for the screw, hence the other is often bored the right size to be a loose fit for the body of the screw. On the other hand, when bolts are used the holes are cast in the iron with no attempt made to bore or ream them to a workmanlike fit. They are large enough to admit the bolt

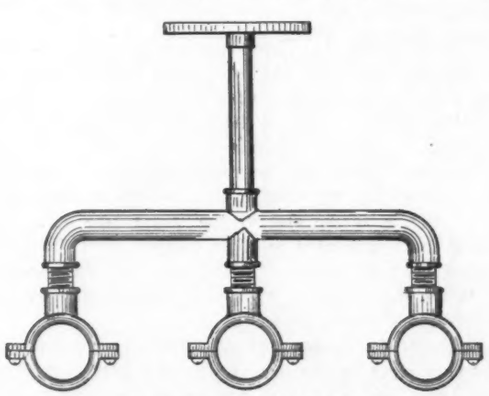


FIG. 5.—TRIPLE PIPE HANGER.

very easily, and if the holes in two separate parts do not correspond, there is still room enough for the bolt to go in without stripping the thread. The hanger is just as strong as it would be with turned bolts and reamed holes, while the cost is much less.

The hanger shown by Fig. 4 is designed for two pipe lines, one above the other. The rings are of equal diameter in the

illustration, but they can be changed for different sizes if desired. So far as the pipe alone is concerned, it looks better to have the larger one in the lower ring, but when the hanger is considered the larger pipe ought to be near the ceiling. This is partially due to the fact that the ring and plate would be

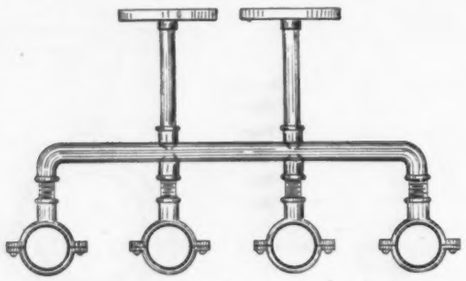
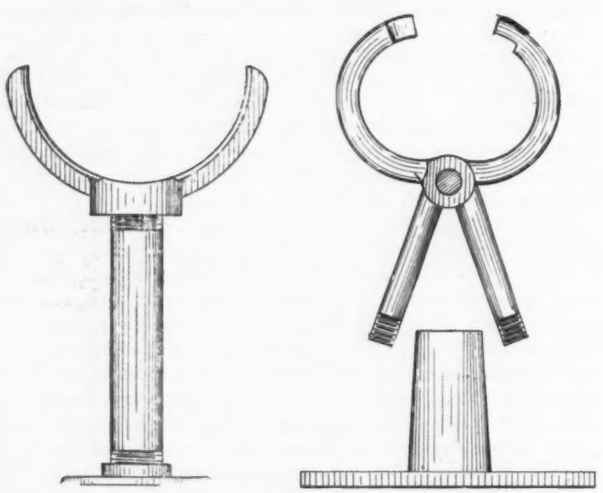


FIG. 6.—HANGER FOR FOUR PIPE LINES.

heavier for the greater diameter. Then the other appears as an attachment only, giving the whole a natural appearance from a mechanical point of view. This scheme constitutes a very neat arrangement for a certain case that was referred to the writer a short time ago, where steam was to be carried through a shop to heat the office, which was located as far away from the boilers as possible. The shop floor consisted of concrete laid directly on the earth, hence a return pipe could



FIGS. 7 AND 8.—PIPE SUPPORTS.

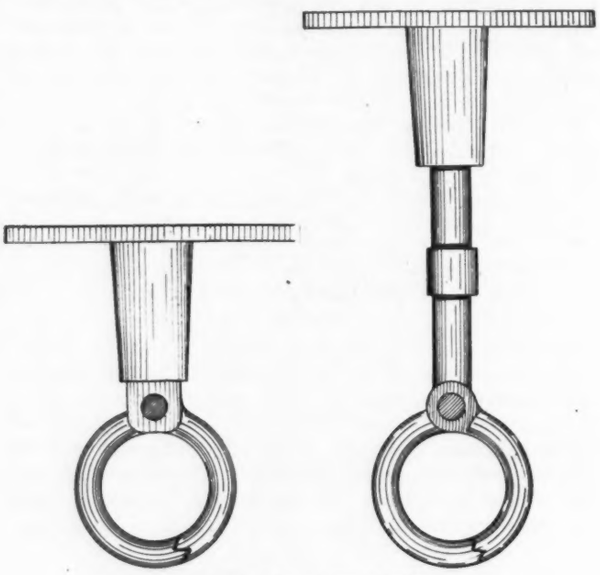
not be located under it. There was a good chance to hang the steam pipe overhead, with the return pipe directly under it, thus making a double pipe hanger very convenient. One difficulty to be overcome in such a case is the necessity for giving the pipes proper pitch in opposite directions. The steam pipe ought to pitch from the boilers and the return pipe toward them. This can be accomplished by using a short nipple between the rings shown in Fig. 4 at the end of the steam pipe and gradually increasing the length used in other hangers until the maximum is reached near the boilers. Water can be raised from a receiver below the radiators by a trap and discharged into the above-mentioned return pipe.

Fig. 5 illustrates a neat and practical arrangement of rings for carrying pipes by the use of one base plate. It is a good idea to apply this triple-ring hanger to the support of pipes of equal diameter, but where they must differ, the larger should be located in the center, and two of the same size used in the others to balance the whole. It is not necessary to carry the pipes all on the same level as the length of nipple can be varied at pleasure.

Fig. 6 shows four rings supported by means of suitable connections from two plates, giving a symmetrical, firm and well-balanced support for four pipes, maintaining the proper distance between them at all times, while either one or all of them can be taken down at pleasure without disturbing anything except the supporting part, which is held in place by two screws.

Fig. 7 illustrates a pipe rest of simple design. In many cases the return pipes of heating systems are located near the floor in the basement and are suspended by extension hangers from the ceiling. A pipe rest located directly on the floor is more substantial, is less prominent and is affected less by contraction of expansion due to changes in temperature, therefore, it seems to be more desirable. When a 4-in. pipe that is always full of water when in service is suspended by extended hangers, the central part of which consists of ⅜-in. pipe with imperfect threads and loose couplings, there is evidently much chance for improvement along this line, yet these conditions represent common practice.

The scheme shown in Fig. 8 can be used as a pipe rest in the position indicated or may be reversed and converted into a hanger. It is shown open, ready to be clasped around the pipe. When closed it can be screwed into the plate with which it belongs, but, of course, it is necessary to turn the plate for this purpose, also to secure the desired height. Fig. 9 represents the hanger clasped and adjusted in the plate ready for use. When made in this form it is adjustable to only a limited ex-



FIGS. 9 AND 10.—PIPE HANGERS.

tent, but nipples of any required length can be used, as illustrated in Fig. 10, thus extending the hanger and its field of usefulness at the same time.

The extensive use of iron girders for supporting the floors of shops and factories demands the manufacture of appliances for attaching hangers to the underside of these girders, to carry steam, water and gas pipes of various sizes. Fig. 11 shows a simple clamp which proves useful for this purpose as it hooks

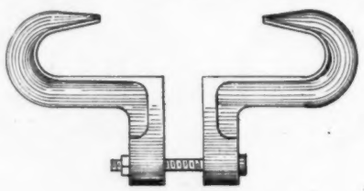


FIG. 11.—CLAMP.

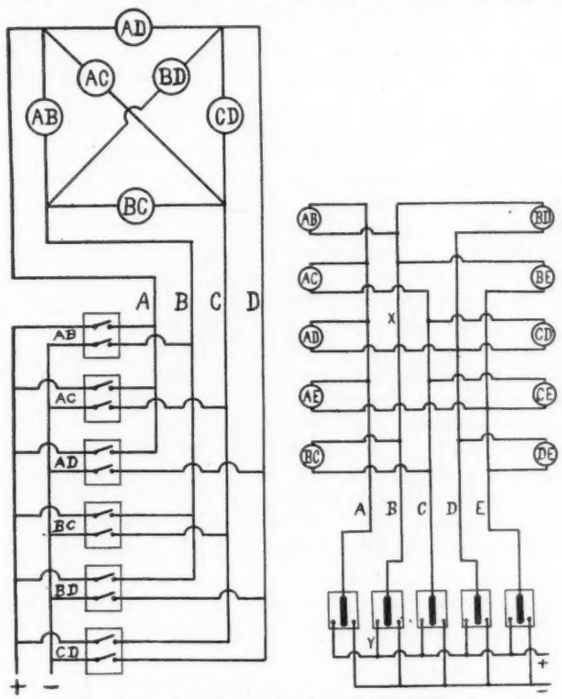
over both edges of the lower side of a girder and becomes a very firm and reliable support. The central space between the hooks at their base should be filled with iron or some other suitable substance, provided the bar or link does not fill it, in order to make a good appearance when the hanger is complete.

LETTERS ON PRACTICAL SUBJECTS

A METHOD OF OPERATING SIGNALING DEVICES.

The method here described enables one to operate any one of a number of signaling devices, such as lamps or relays, at a distant point with the use of fewer wires than are required by the ordinary methods, and does not require the use of special apparatus. The receiving device must, however, respond to some definite voltage, but not to half of this voltage. For this purpose incandescent lamps are suitable. The voltage may be so selected that the lamps receiving one-half of this voltage just fail to glow. The lamp receiving full voltage will then be lighted.

Fig. 1 illustrates a sending station (at the bottom of the illustration) connected by four wires to a receiving station (at the top of the illustration). At the receiving end a lamp is connected between every possible pair of wires, all of the lamps being alike. There are six such pairs of wires: *AB, AC, AD, BC, BD, CD,* and the lamps are here designated by the wires to which they are connected. Let any two wires, such as *A* and *B*, be supplied with an e.m.f. of *e* volts at the sending station by closing the switch *AB*. Neglecting the drop in the wires, the lamp *AB* receives the full voltage *e*. The current also flows from *A* to *B* through two series of two lamps each, *AC* and *BC* in series, also *AD* and *BD* in series. The lamp *CD* is connected to the middle points of the two series of two lamps, and both terminals are at the same potential. Lamps *AC, BC, AD, BD* receive the voltage $e \div 2$, and if *e* be properly selected they just fail to light. Of the six lamps, *AB* alone receives voltage enough to cause it to light. On account of the symmetry of the connections the same reasoning may be applied to any other lamp.



FIGS. 1 AND 2.—SIGNALING CIRCUITS.

Suppose now that there are *N* wires, designated as *A, B, ... N*, between the stations. There are $N(N-1) \div 2$ combinations of two wires each, and consequently any one of that number of lamps may be lighted. Let it be the lamp *AB* and let *i* amp be the current consumed by a lamp when fed with the voltage *e*. When the voltage *e* is supplied to the wires *A, B*, lamp *AB* receives this voltage. Current also flows between *A* and *B* through the various series of two lamps each, such as *AC* and *BC, AD* and *BD, ... AN* and *BN*, there being $N-2$ such series, since there are $N-2$ wires besides *A* and *B*, and each of these wires joins to the middle point of a series of two lamps. Each of the other lamps, such as *CD, CE . . . . CN, DE, ...* etc., neither of whose terminals connect to either *A* or *B*, joins the middle points of two series of two lamps each and receives no current. Each series of two lamps consumes $i \div 2$ amp, neglecting the variation of resistance with temperature, and $N-2$ such series consume $(N-2)\, i \div 2$ amp. Adding to this the current *i* consumed by the lamp *AB* the total current consumed is $Ni \div 2$. The economy in wire is gained at the expense of using $N \div 2$ times as much current as would be required if it flowed through only one lamp.

In the table are given, for the various number of wires between stations, the number of lamps of which any one may be lighted at will, and the current required for operation, where the current used by one lamp receiving the voltage *e* is taken as unity.

Number of wires.	Number of lamps.	Current.
2	1	1.0
3	3	1.5
4	6	2.0
5	10	2.5
6	15	3.0
7	21	3.5
8	28	4.0
9	36	4.5
10	45	5.0
11	55	5.5
12	66	6.0

To connect the wires to the source of electricity double-pole, single-throw switches, as shown in Fig. 1, may be used; or a double-throw switch may be substituted for two single-throw switches.

Fig. 2 shows a five-wire system controlling 10 lamps, but with a single-pole, double-throw switch for each wire. To light a given lamp, for example, *CD*, the *C*-wire switch is thrown in one direction and the *D*-wire switch in the other. The first switching device requires more complicated wiring, but is more easily operated since there is but one switch to be operated for each indication and each switch may be designated by the indication that it controls. The mistake of closing two switches, such as *BC* and *CD*, at the same time may result in a short-circuit unless special means, such as resistance between the source of electricity and the switches, be used to prevent it.

The second method requires the operation of two switches for each indication, and it is less easy to designate what switches to operate in order to give a certain indication. The number of different signals that may be transmitted with a given number of wires may be doubled by using between each pair of wires two receiving devices sensitive to opposite directions of current. These may be polarized relays. So far the resistance of the wiring has been assumed to be negligible with reference to the resistance of the receiving devices. If the resistance is symmetrically distributed, for example, equal resistances placed in series with each of the lamps or equal resistances located in each of the line wires; this requires that the voltage at the sending end be higher than that required by the lamps, but does not unbalance the distribution of voltage to the lamps. If the resistance is unsymmetrically located, as, for example, an abnormally high resistance at the point *X* or *Y*, Fig. 2, the lamps may not always receive the proper voltage and a special study of the case should be made where it is necessary to have the resistance unsymmetrically placed.

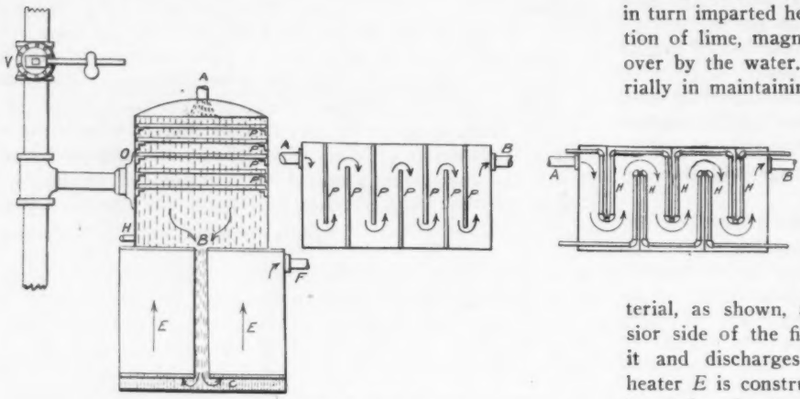
The foregoing shows that an increased number of signaling devices may be operated, one at a time, with a given number of wires, by placing a signaling device between every wire and every other wire at the receiving station. These devices may be lamps, relays, etc., which respond to a given voltage, but not to half of the voltage. The saving in wire is accompanied by an increase in the current required.

Elizabeth, N. J. F. P. McDermott, Jr.

FILTERING BOILER FEED-WATER.

The fact that feed-water should in most cases be filtered before being fed to steam boilers is now almost universally recognized, and filters are employed in very many modern plants. There are various systems employed for the filtration and

elimination of the scale-making ingredients carried in suspension by the water. Some feed-water heaters are constructed to heat and filter the water at the same time, while others receive the water after it is filtered by an independent filter. Some years ago no attempt was made to filter the water for steam boilers. At first the cold water was pumped directly into the boiler without passing it through any kind of heater, thus



FIGS. 1, 2 AND 3.—FEED-WATER FILTER.

facilitating the rapid destruction of the boiler, not to mention the waste of fuel incident to such practice. The addition of the feed-water heater to the plant served to lengthen the working life of the boiler, and resulted also in a more economical use of fuel. No engineer operating a plant of any pretensions would think of doing without a feed-water heater nowadays, and in the near future small plants will also be equipped with some system of filtration that will insure clean feed-water for the boilers.

To pump impregnated unfiltered water into a boiler is poor engineering to say the least, especially when the enormous amount of heat thrown away daily in the exhaust steam of the various plants is taken into consideration. Fig. 1 illustrates a sectional view of a type of feed-water heater that has combined with it a filtering chamber. The cold water and drips from different apparatus enter the heater at *A* and fall into pan *P*. When this pan is full, the water overflows and falls into the next pan P^1 in the form of a thin sheet or film, and this overflowing of the water is continued from pan to pan until it enters pipe *B*. The water now falls into chamber *C* and passes upward through the perforated bottom or screen, and through whatever filtering material may be inserted in the chamber *E*. The water will now appear at pipe *F*, which is connected with the boiler feed pump. If the quantity of water filtered and heated is greater than the amount required by the boilers, the surplus water will overflow at *H* and pass out to the sewer or storage tank. The exhaust steam entering the heater passes through the oil eliminator *O*, and striking the thin sheets of falling water raises the temperature of the water considerably. If the amount of water entering the heater be lessened and the back pressure valve *V* be partially closed, the temperature of the feed-water may increase to 210 deg. Fahr. In operating a heater and filter of the "open" type it is good practice to gage the amount of water entering the heater so as to prevent waste or loss at the overflow. Fig. 2 is a plan view of an independent filter and is not combined with a heater. The cold water and returns from the various drips, etc., enter at *A* and after circulating through the filtering material as indicated will flow out at *B*. The water is then taken by the pump and discharged into a "closed" heater, whence the water flows to the boiler. With this style of filter it was found that the elimination of scale-making ingredients carried in suspension by the water was not sufficiently rapid, so the partitions *P P*, etc., were removed and heating coils inserted in their place and sheet-iron partitions were fitted between each coil, as shown at *H*, Fig. 3. Exhaust steam being utilized to heat the coils, the heated coils in turn imparted heat to the water, compelling a greater deposition of lime, magnesia or what injurious material was carried over by the water. The filtration of the water assisted materially in maintaining a clean feed-water heater, which in turn aided an elevation of the feed-water temperature. Fig. 4 illustrates an important type of filtering plant, the filter being shown at *F*, the foreheater at *E* and the main closed heater at *H*. The feed-water passes through the foreheater *E*, whence the water flows into the gravel or coke side of filter *F*, through the filtering material, as shown, and thence up through the sand or excelsior side of the filter and out at *D* where the pump *P* takes it and discharges it into the main heater *H*. The foreheater *E* is constructed with three chambers, the middle chamber being fitted with a number of brass tubes. The upper chamber is divided in two parts by the plate P^1. The lower chamber is the largest and is provided with a mud-drum and blow-off cock. The cold feed-water flows through the tubes on one side and up through the other side as indicated, thence out to filter *F* through pipe *I* where it circulates through the filtering material as before explained. The exhaust enters the tube chamber of the foreheater *E* as shown, and circulates around the outside surface of the tubes. The cold water entering the tubes causes condensation, which is carried off by means of a drip shown at *D*. By lowering the back-pressure valve *V* or by partially closing the valves *M* and *N*, the feed-water temperature can be raised to the boiling point or above it, depending of course on the amount of exhaust steam flowing in the main exhaust pipe *G*. The addition of the foreheater to the filtering plant eliminated a large amount of deleterious matter that would otherwise have to pass through the main filter. Thus the filtering material in *F* remained clean for a much longer period of time, thereby obviating the necessity of changing it often. Previous to the installation of the foreheater the filtering material had to be changed every six months, but now once a year is sufficient. Of course, the mud drum attached to *E* should be blown regularly and particularly in the morning before starting up the plant, if the latter is shut down over night.

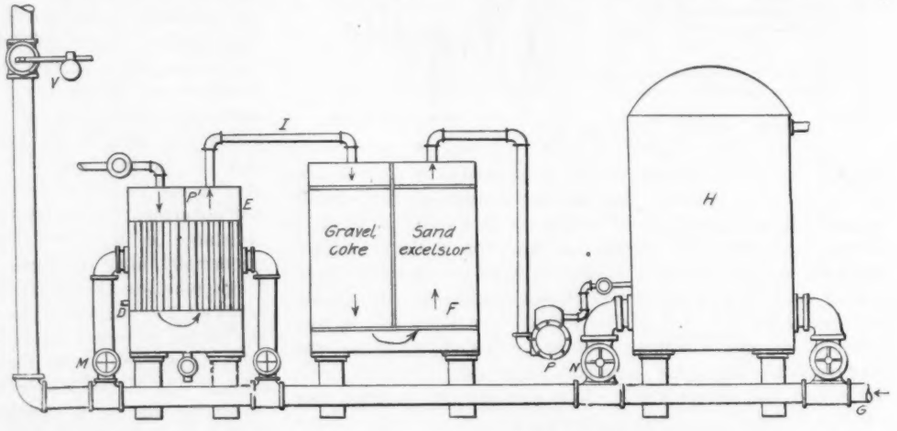


FIG. 4.—CONNECTIONS OF FILTERING PLANT.

BOSTON, MASS. K. W. DENTON.

ATTRACTIVE ELECTRIC SIGNS.

Electric signs may be divided into three classes: those formed of letters giving the name of the concern or the merchandise

and perhaps extolling its advantages; those which show in part or in whole pictures of the articles to be advertised, and freak conceptions which arrest the attention of the observer for a time by the novelty or mystery. It is with the third class of sign that the writer wishes to deal. The design, construction and operation of startling electric signs have taken the attention of some very excellent designing engineers, though it is safe to predict that this matter is at present in its most crude state and that it will continually increase in efficiency and attractiveness. Meanwhile, the demand for freak signs is increasing rapidly and it behooves both the designing engineer and the electrician to give this matter the attention which it demands and is entitled to. A sign arranged for the corner of a building at the intersection of two streets is diagrammatically represented by Fig. 1. The building walls *a* and *b* have been cut away, as shown, leaving the post at the corner if required by the building-inspecting department. If they will let the corner be removed so much the better. The height of each opening is equal to its width, so the holes in the walls must be square or they may be made round, if so desired. The inner sides of the openings thus made are closed by means of mirrors *c* and *d*. The presence of these mirrors makes the action of the apparatus all the more striking. The mechanism of the installation consists of the arms *e* and *f*, which are journaled at the center upon a shaft.

Each of these arms carries one incandescent lamp. Thus there are four lamps upon the arms, two of which are white and two are red. The arms are arranged to revolve in opposite directions and make about 60 to 70 complete revolutions a minute. A small electric motor is used for rotating the lamp-arms and for driving the commutator, which is necessarily the vital portion of this piece of apparatus. Before describing the commutator it will perhaps be best to try to represent what this apparatus accomplishes in the way of disturbing the peace of mind of the passerby until he must look at the whirling light in spite of himself. Fig. 2 shows the manner in which the lamps are displayed. The apparatus is made to go through a sort of cycle consisting of 16 complete revolutions of each double arm. The commutator makes one complete revolution during each cycle, and therefore must be geared to the revolving arms in the proportion of 1 to 16. Referring to diagram *A*, Fig. 2, the arms *a* and *b* carry white and red lamps, respectively, and are marked "white-1" and "red-1." These arms revolve clockwise while the other set of arms, *c* and *d*, revolve counter-clockwise upon the same axis and carry white and red lamps known as "white-2" and "red-2" and are distinguished in that manner through all the following diagrams. The arrows

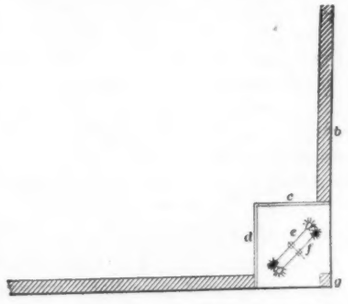


FIG. 1.—DIGRAMMATIC REPRESENTATION OF A FREAK ATTENTION COMPELLER.

in the circle surrounding each diagram indicate the direction in which the lamps revolve, and this may be simplified by remembering that red and white lamps marked "1" always revolve clockwise, while red and white lamps marked "2" always revolve counter-clockwise. This must be fully understood in order to comprehend the manner in which the various effects are secured as shown by the diagrams in Fig. 2. In the arrangement here described each effect is sustained through two complete revolutions of the arms of the "startler," as this device may well be called. As each diagram represents one complete revolution of both sets of arms, therefore, the diagrams are shown in pairs, each pair being alike. Diagrams *B* and *C* show white lamps only, but revolving in opposite directions. Diagrams *D* and *E* show the white lamps revolving in opposite directions with a flash of red each time the white and red lamps cross each other. This is one of the most "teasing" effects presented by this mechanism. The next diagrams, *F* and *G*—the third effect—is simply one white and one red lamp revolving in opposite directions. This effect merges into the next, consisting of revolving red lamps in opposite directions,

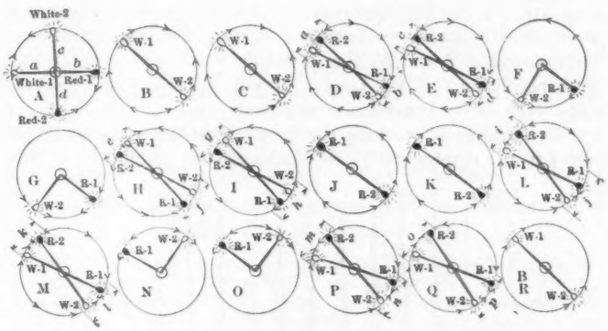


FIG. 2.—LIGHTING CYCLE WORKED OUT IN REVOLUTIONS.

enriched by flashes of white when the white and red lamps pass each other, much the same as in effects *D* and *E*, except that those were white with red flashes, while *H* and *I* are red with white flashes. This effect merges into solid red lights revolving in opposite directions during the revolutions *J* and *K*, then the red lamps are flashed with white again in effects *L* and *M*, which in turn merge into white and red in opposite directions much the same as in *F*, *G*, except that the lamps, both white and red, revolve in opposite directions in effects *N* and *O*. Effects *P* and *Q* call for another flashing of red against white lamps revolving in either direction, the white lamps revolving steadily in either direction, while the reds are flashed at the point of opposition of the lamps, to use an astronomical term. If the operations be tabulated the following will be the result:

A—Arrangement of lamps and arms.
BC—Two revolutions, No. 1 white clockwise, No. 2 white counter-clockwise.
DE—Two revolutions, Nos. 2 and 1 white clockwise, Nos. 1 and 2 red flash counter-clockwise.
FG—Two revolutions, No. 1 red clockwise, No. 2 white counter-clockwise.
HI—Two revolutions, Nos. 2 and 1 white flash clockwise, Nos. 1 and 2 red counter-clockwise.
JK—Two revolutions, No. 1 white and red clockwise, No. 2 red and white counter-clockwise.
LM—Two revolutions, Nos. 1 and 2 white flash clockwise, Nos. 1 and 2 red counter-clockwise.
NO—Two revolutions, Nos. 1 and 2 white clockwise, Nos. 1 and 2 red counter-clockwise.
PQ—Two revolutions, Nos. 1 and 2 white clockwise, Nos. 1 and 2 red flash counter-clockwise.
BC—Two revolutions. Same as *BC* at beginning, thus completing the cycle.

The manner in which the lighting and the flashing of the lamps may be effected is shown in Fig. 3, which represents a 10-brush commutator and the lay-out for the same. The line wires are attached to the outermost sections of the commutator, or rather to the brushes belonging to those sections. Each lamp has been given two brushes: one for the positive, the other for the negative terminal of the lamp wires. While the working of the sign could be accomplished by means of only one commutator section to each lamp, the negative connections being in common, it is evident that the display possibilities are much greater where there are brushes for each lamp return wire, as well as for the positive wire. Therefore, the double brushes were used. It will be observed that the positive brushes are all grouped together at one end of the commutator, while the negatives are grouped in a corresponding manner at the other end. This permits one-half the commutator sections to be in electrical contact with each other while insulated from the commutator shaft and from the other half of that device. The negative end of the commutator is electrically connected and insulated in a similar manner, thereby securing a very easily made and maintained commutator. By referring to the development portion of Fig. 3, the arrangement of the necessary

contacts becomes visible at a glance. The sections are marked +, *W1* +, *R1* +, *W2* +, *R2* +, *R2*—, *W2*—, *R1*—, *W1*—, and —. These characters refer to leads to and from lamps of corresponding color and direction of rotation, bearing in mind that all the lamps marked 1 revolve in a clockwise direction, while those marked 2 revolve in a counter-clockwise direction. The column of letters at the left of the development diagram refers to the revolutions of the lamp-arms. The dotted lines extending horizontally across the development represent the movement of the commutator during one revolution of the lamps. Thus, the spaces to the right of *JK* between the dotted lines are the particular portion of the commutator which will be revolved beneath the brushes during the two revolutions diagrammed at *J* and *K*, Fig. 2, which would be the ninth and tenth revolutions of the lamps. It will be seen that there are some very short commutator segments shown, and these are for the purpose of working the flash which takes place at four points in the display cycle. For instance, in revolutions *C* and

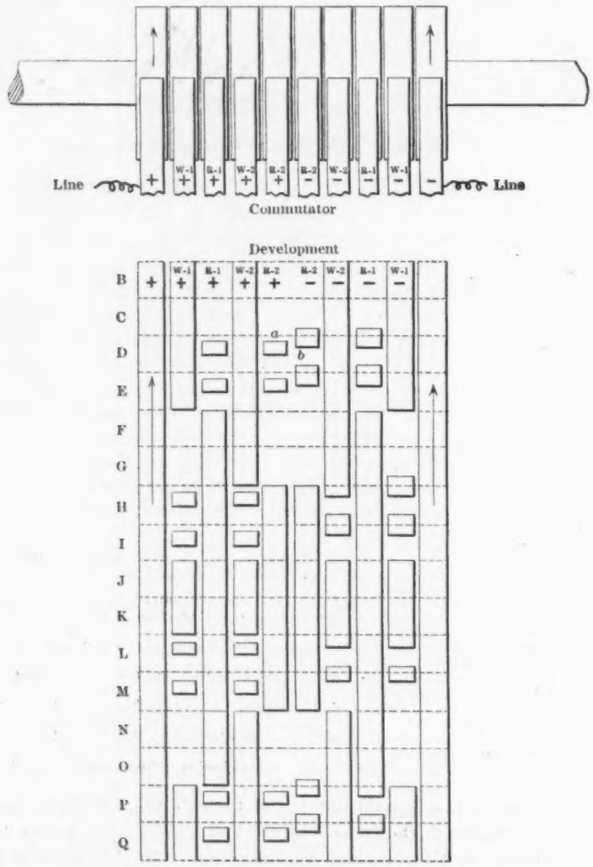


FIG. 3.—COMMUTATOR AND DEVELOPMENT.

D, *R1* + and *R2* + are to give flashes at some predetermined portion of the revolutions *D* and *E*. The position of the contacts in the dottel space shows that contact will be made and the red lamps lighted somewhere in the first quarter of each revolution named. This is easy enough. Although the exact point at which it is desired the lamps shall glow is not shown by Fig. 3, it cannot be known until a lay-out on a larger scale shall have been made of the angular revolution of each pair of lamps and proper allowance made for the time necessary to bring the lamps to a bright glow after the commutator and the brush have made contact. This is comparatively easy, and the time can be determined with great exactness by means of a pair of trial contacts, which can be advanced or retarded to determine the exact point at which the brush should touch the commutator segment. But easy as the proper lighting of any flash-lamp may be, the extinguishing of that lamp at the proper instant is quite a different matter. In Fig 2 it will be noted that the flash points are indicated by the letters *a, b, c, d, e, f, g, h, i, j, k, l,* and *m, n, o, p*. Each of the spaces indicated by one of these letters covers approximately one-eighth of a complete revolution of the lamps and arms. The space covered by any one of these letters would then equal one-eighth or less of the proper space *DE, HI, LM* or *PQ*, shown between the dotted lines in Fig. 3. Allowing the commutator to be a little more than 5 in. in diameter, the segments representing revolutions of the lamps would be 1 in. long, and to make a flash of one-eighth of a revolution a brush must be on a segment exactly ⅛ in. long. This is not practicable. There would be no wearing quality to such brushes, and there could be not thickness to the brush which must be presented radially to the segment in order to make and break the contact quick enough. To avoid all this trouble and to allow the regular tangential brushes to be used, the expedient has been adopted of putting in good, wide contact segments and then cutting out the lamps by means of the negative brush-segments. It is for this purpose that the double-brush arrangement for each lamp is found advantageous. Considering, for example, the segments in section *D* below *R2* + and *R2*—, it will be noted that the distance between the forward end *a* of the positive segment and the rear end of negative segment *b* is very small. But the distance *ab* represents the time electricity will pass through lamp *R2* and the lag due to time of lighting and time of extinguishing can be closely allowed for by sliding *a* or *b* ahead or backward, as found necessary. In addition to the commutator shown by Fig. 3 it will be necessary to provide collecting rings on the shaft about which the lamp-arms shall revolve. Two plain rings and brushes for each lamp will be necessary, four rings to each pair of arms, or eight rings in all. These may be mounted upon the hubs of each pair of arms. There will be very little wear, as no sparking need occur, the circuit never being broken between these rings and their brushes. In addition to a 1 to 16 gearing (positive) for driving the commutator described and shown by Fig. 3, there must also be equal gearing connecting the two sets of lamp-arms so that these shall revolve in opposite directions at the same rate of speed. Link belting or spur gears may be used for this purpose, but the engineer should not trust to friction gearing, such as ordinary belts, for the proper synchronism cannot be maintained. By means of six sprocket wheels, including a nine-toothed one on a motor running at 300 r.p.m. and a few feet of link belting and one countershaft, the lamp-shaft and the commutator can be driven in good shape, the reverse motion of the two sets of lamp-arms being included in the material noted above. This is a cheap drive which may be used to advantage when there is a space of several feet between the motor and the shaft upon which the lamp-arms are located. The countershaft in this case should be placed close to the motor, and the commutator next to the lamp-shaft, though the latter is not necessary. It simply brings the commutator close to the lamps, but the distance between motor and lamp-shaft is necessary on account of the slight angular arrangements requisite to obtain the required reverse motion in one of the lamp-arms with the chain drive.

Willoughby, Ohio. James F. Hobart.

CONVENIENT LAMP SOCKET.

Oftentimes electric-light companies receive complaints from customers of low voltage and poor light, whereas the trouble may be due to old lamps. To send a man with a voltmeter to measure the potential at the meter, while it may satisfy the electric-light company, may or may not satisfy the customer. It has been suggested that in place of a voltmeter test a man convince the customer by means of a new lamp. For this purpose a double socket may be connected to a flexible cord to the other end of which a plug is attached. If the voltage is right, it is an easy matter to convince a customer that the trouble is with the lamps by simply burning a new lamp and one of the customer's lamps side by side in the double socket. The difference is seen in an instant and may be accentuated by first burning the old lamp over a paper and then the other.

Columbus, Ohio. Henry Wittpenn.

QUESTIONS AND ANSWERS

Is it possible to correct or rewind a 110-volt direct-current fan motor in any way to operate on a 110-volt, 60-cycle circuit? C. J. B.

A fan motor primarily designed for direct-current circuits cannot be made to operate satisfactorily on alternating-current circuits. There are, however, on the market series alternating-current commutator motors designed primarily for such service which will also operate satisfactorily on direct current.

Kindly give a brief history of the electric arc lamp. C. C. S.

The first practical arc lamp was that of Foucault, 1844. In this hard carbons were first used for electrodes, and the lamp was regulated by hand as in the case of the present projection lamps. The first automatic arc lamps were those of Wright, 1845; Staite, 1847; Archereau, 1848, and Foucault, 1849, none of which, however, was a practical form. Lacassagne and Thiers in 1856 were the first to use the differential principle. Serrin, in 1857, and Duboscq, in 1858, completed the clockwork lamp, now used entirely in Europe with only changes in detail from the originals. The clutch lamp was patented by Brush in 1878.

If a transformer is supplied with a primary e.m.f. of 1000 volts and has 1000 turns on the primary, how many turns must there be in the secondary to have an e.m.f. of 104 volts at the terminals of the secondary? J. R. L.

When upon the primary terminals of a transformer having 1000 turns there is impressed an e.m.f. of 1000 volts, the e.m.f. of the transformer is 1 volt per turn. This same value of voltage will be obtained on each turn of the transformer independent of whether it belongs to the primary circuit or the secondary circuit, so that in order to obtain a secondary e.m.f. of 104 volts it will be necessary to use 104 turns. You will, of course, understand that the secondary e.m.f. would be 104 volts at no-load and that it will decrease with the increase of load on account of the losses within the transformer, reaching probably 100 or 102 volts at full-load.

An alternator supplies energy for a three-phase induction motor rated at 35 hp, 88 amp, 220 volts. The meter readings in the station indicate 8 amp, 2600 volts, and the power factor is about 70. The transformers are connected in delta, and the primary is fused for 18 amp. The fuses for the motor are rated at 120 amp per phase, yet at times they blow. I claim that the motor is overloaded and delivers about 40 hp to the shaft; but in the mill where the motor operates they claim that the motor does not give more than 20 to 25 hp. E. B. DeP.

An induction motor designed for a normal current of 88 amp at 220 volts is not operated at overload when it requires from the supply system a current of 8 amp at 2600 volts. The normal current at the latter voltage would be 7.5 amp, while the extra ½ amp would hardly be more than sufficient to supply the extra transformer loss. According to the data supplied your three-phase, 35-hp motor and the connecting transformers are using a total of about 25 kw, which is not excessive, although the motor is practically fully loaded.

Will you kindly inform me if there are any articles describing the principle and advantages of the split-pole synchronous converter? Also articles regarding the improved type of single-phase commutator motor referred to in the editorial in the issue of January? L. D. B.

The split-pole synchronous converter is a machine invented by Mr. Woodbridge and described several times in papers presented before the American Institute of Electrical Engineers. It was discussed quite fully at the meeting of the American Institute of Electrical Engineers, held in New York during February, 1908, and also at the recent Atlantic City convention of the Institute. Outlined descriptions of this machine were given in our columns. The improved type of single-phase commutator motor referred to in our issue of January is a machine invented by Mr. Alexanderson, of the General Electric Company, and described by him in a paper presented before the American Institute of Electrical Engineers in January, 1908. An outline of this machine was also given in our columns.

I am seeking information on the following: In a magnetic exchange of 100 telephones giving party-line rural service at $12 per annum, how much of the amount is usually required for exchange or central service? How much for the care of subscribers' stations? How much for use of telephone instruments? For reserve against damage by storms? For profit? C. S. S.

According to the most reliable information that we have been able to obtain, the operating expenses of the average telephone system of the United States are subdivided in, roughly, the following proportions:

Salaries of general and other officers	$5.25
Salaries of clerks, etc	4.65
Wages	26.37
Maintenance and legal expenses	13.33
Rentals and royalties on instruments and apparatus	2.84
Rentals of office and other real estate	2.50
Rentals of conduits and underground privileges	0.68
Telephone traffic paid or due to other companies	0.44
Miscellaneous	0.82

The operating expenses as outlined above form about 70 per cent of the gross receipts from operation.

Have had a strange experience with a generator, and would thank you for any information on the matter. I was turning down the commutator of a 100-kw, 500-volt generator taking energy from another similar machine to supply the shunt-field coils, and energy for the armature was taken from an exciter. The exciter was working on a motor-generator set, the motor of which was wound for 2200 volts and the generator of which was giving 60 volts. The exciter was working as a compound machine and was rated at 9 kw. The field circuit was closed, and on closing the 60-volt armature circuit the machine made 8 or 10 revolutions in one direction and then quickly stopped and started to turn in the opposite direction 4 or 5 times, when the armature fuse blew. Evidently the series field in the exciter bucked the shunt field; but they were both working together or in the same direction when started. After short-circuiting the series field coils in the exciter, no further trouble was experienced. H. F. F.

The action described can be attributed to the interrelations existing when the armature of a separately excited machine is connected to a series-wound generator. This action is fully described in Nichols' "Physical Laboratory Manual." When the armature of the separately excited machine is stationary, the series-wound generator tends to send current through the armature in a certain direction and to accelerate this armature to a certain speed. As the armature increases in speed its counter-voltage increases also so that finally the counter-voltage equals and overpowers the voltage of the series generator. The current in the circuit is then reversed, the magnetism of the series generator is also reversed; it builds up e.m.f. in the reversed direction and sends a reversed current through the armature of the other machine, brings it to rest and accelerates it to a certain speed in the reversed direction.

An alternating-current induction motor is wound for 220 volts, two-phase, 60 cycles. The machine has 72 coils and is of the four-pole type. Can it be changed to a three-phase motor either "delta" or "Y" connected without reducing or increasing the voltage? If the voltage is reduced or increased, what percentage of the above voltage will it be? C. F. K.

The coils of a two-phase, 220-volt, 72-slot induction motor of the four-pole type can readily be rearranged so as to render the motor useful on three-phase circuits. There being 72 coils total, there are 18 coils per pole and hence nine coils per pole per phase (per group) in the motor as now wound. These coils should be disconnected and then rearranged into 12 groups, each containing six coils. There are now three groups per pole, one group being for each phase. The four groups for each phase should be joined in proper series parallel arrangement to produce three windings for the three phases. When these three windings are joined in star the motor could be operated at the same magnetic density as used before at 269.3 volts, or they could be joined in delta and operated at 155.5 volts. It might be well to remark in this connection that instead of operating the star connection at, roughly, 270 volts it be operated at 220 volts; the motor could carry its normal full load at a slightly increased copper loss and a slightly decreased iron loss, so that the efficiency would be practically unchanged. This is the method ordinarily employed.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

The Electric Automobile at Rockford, Ill.

About three years ago an account was given of the remarkable development of the electric automobile business at Rockford, Ill. Since that time the number of electric vehicles at Rockford has doubled, and the city still holds the record of having the largest number of electric automobiles per 1000 of population of any city in the United States. Assuming that the population of Rockford is 50,000, in accordance with the post-office census, Rockford now has 2.6 electric automobiles per 1000 of population, there being 130 of these vehicles in use.

The electric automobile business in Rockford has not been the work of a day, but has been a gradual development. The unusual number of vehicles is due to the combination of several favorable conditions. The city is fairly level and well paved, and its size is such that the electric automobile is sufficient for all purposes within the city limits and for a limited amount of touring to neighboring towns. For a number of years direct current was distributed over an unusually large area, so that nearly all the larger residences were supplied with direct current easily available for charging automobiles. As a result of this, many private garages were built. A third and very important element in connection with starting the electric automobile business in Rockford was the care of batteries by the central-station company. The company had a storage battery of its own for voltage regulation purposes, located behind its offices in the main part of town. Adjoining this battery-room was a charging shed where charging would be done at any time. Besides charging the company's battery, the battery man would look over a consumer's vehicles and make any necessary small repairs. He would also keep track of the condition of batteries and would not allow them to deteriorate for lack of attention as they might have done without such expert care.

At present the central-station company has largely withdrawn from the battery charging and maintenance business, leaving this to the public garages. In this way the business has been gradually transferred and the garages are encouraged to sell and maintain electric vehicles. There are six public garages which do charging that are also prepared to maintain storage batteries.

RATES.

The Rockford Electric Company makes a rate of 4 cents per kw-hour to public garages which sign a contract agreeing not to charge during the company's peak. As a matter of fact, there would seldom be any desire to charge during the peak, as the vehicles are frequently in use during the early evening. These garages charge 6 cents per kw-hour for electricity used in charging. In other words, the wholesale rate is 4 cents and the retail rate 6 cents. The garage gets the 4-cent wholesale rate by virtue of its non-peak contract.

The rate to private garages is 6 cents per kw-hour, which is the same as the rate charged by the public garages. The charging in private garages would not naturally be on the peak, because if the charge were begun early in the evening the owner will have to get up in the night to cut the current off unless he let the vehicle charge all night and thus become much overcharged. The natural course is to let the vehicle begin charging at bedtime and cut it off in the morning.

There are 55 private garages. Some of these house several vehicles. Only two private garages use alternating current. Until two years ago there was nothing but direct-current service in the city. Although most of the residence district in which these garages are located has been changed from direct to alternating-current distribution for lighting within the past two years, a direct-current charging circuit has been allowed to remain through this district. On this circuit but little attention has to be paid to voltage regulation. It is being maintained because the company did not wish to ask all of its automobile customers to purchase rectifying outfits when the change was made to alternating current.

Among the various garages are agencies for the following electric vehicles: Pope-Waverly, Babcock, Baker, Woods and Studebaker.

YEARLY REVENUE.

The yearly revenue of the Rockford Electric Company from vehicle charging for the year 1908 was $60 on the average for each vehicle in the city. The average yearly income for each vehicle in private garages was $42.50. This indicates that the vehicles charged at the public garages are used more than those in the private garages. This is as would be expected.

The Rockford Electric Company also does charging of sparking batteries for gasoline automobiles at 50 cents each, the rate made by the public garages.

The largest garage, kept by the Joslyn Automobile Company, keeps a record of the batteries on all vehicles which at any time come under its care so as to enable it to give owners the best service possible.

Non-Peak Power at St. Cloud.

The Public Service Company of St. Cloud, Minn., operating in a town of 10,000 population, has 90 motors connected to its circuits. Most of its power is obtained from water. One interesting feature of this company's load is that some of the power is on feeders which the company has the option to disconnect at times of peak load if there is not sufficient capacity at the power house to carry this power load in addition to the lighting load.

A Big Washing-Machine Motor Load.

The municipal electric light plant at New Ulm, Minn., seems to hold the record to date of electric washing-machines in use per 1000 inhabitants. Mr. Adolph Wagner, superintendent of the plant, reports that there are now about 65 electric motors driving washing-machines in the town, the population of which is about 6000. There is thus more than one electrically driven washer for every 100 people. Many of these washers are of the cheaper types, adapted to any kind of power drive, and costing, motor and all, from $30 to $40.

Renting Vacuum Cleaners in Minnesota.

The Albert Lea Light & Power Company has had for some time a $125 Duntley vacuum-cleaning outfit with 1/6-hp motor, which it has rented out at the rate of $1.50 per day, including delivery. An employee of the company delivers the machine at 5:30 p. m. and calls for it at 5:30 p. m. next day. The machine is engaged for several weeks ahead during house-cleaning seasons and for two or three days a week at other times, according to Mr. Ludwig Kemper, manager of the company.

At New Ulm, Minn., a similar machine has been purchased by Mr. Adolph Wagner, superintendent of the municipal plant, and this machine is rented out at the rate of $1 per day, including delivery.

Electric Automobiles at Minneapolis.

There are about 100 electric runabouts and 20 electric trucks in use in the city of Minneapolis. The largest of these trucks has a capacity of 15 tons. The Minneapolis General Electric

Company gives its regular power rates for this class of business. The company has two kinds of power rates, both of which give automobile charging a low figure per kw-hour.

The retail-power rate on the discount meter basis is 7½ cents per kw-hour for the first 52 hours' use per month of the yearly maximum demand; 5 cents per kw-hour for the next 52 hours' use; and 2 cents per kw-hour for all current used in excess of 104 hours per month of the yearly maximum demand.

The retail power rate on a readiness-to-serve basis is $3 per month per kilowatt of yearly demand, plus 2 cents per kw-hour for all current consumed. A maximum demand of 2.5 hp is assumed in all cases for electric runabouts. About half of the electric runabouts in the city are charged and cared for in the owners' private garages. The income to the central-station company from private garages is about $70 per vehicle per year.

Trial Electric Irons in New York City.

The United Electric Light & Power Company, supplying alternating current throughout the Borough of Manhattan, New York City, has recently sent to 100 of its consumers 5-lb. electric irons on six months' trial. In forwarding the irons the company has stated that they are sent without cost of delivery or rental, and are left at the consumer's premises for six months' trial. If at the end of the trial the iron has not proved to the housekeeper's satisfaction that it is a useful, desirable and economical adjunct to the home, it will be called for by the United Company and returned without expense to the consumer. In addition to the irons which the United Company has placed on trial with its consumers, a number of requests have been received and 100 more will shortly be delivered. If at the end of the six months' trial the iron proves satisfactory to the consumer, it will be sold outright by the United Company for $3.50.

Business-Getting Methods of the Edison Electric Light & Power Company, of Amsterdam, N. Y.

By William H. Stuart.

The first electric light plant was started in Amsterdam, N. Y., a city of 28,000 inhabitants, about 1885. The load was carried by one central station operated by three distinct companies: the Amsterdam Arc Light Company, the Amsterdam Street Railroad Company and the Edison Incandescent Light & Power Company. The three companies were consolidated later under the name of the Edison Electric Light & Power Company, which in turn is controlled by the Fonda, Johnstown & Gloversville Railroad Company. Energy is purchased from the latter company and distributed from a substation on Henrietta Street, which is also used for railway purposes. Electricity is received at a potential of 13,000 volts and transformed to a potential of 2000 volts for primary distribution circuits. Secondary 115-volt, single-phase circuits are used for lighting and 230-volt, three-phase circuits for motor service. There are 269 arc lamps used for the street lighting, and the greater part of the commercial lighting load is obtained from business houses, mills, signs, etc. There are quite a few flatirons and also some heating and cooking appliances attached to the company's lines. The motor load aggregates 766 hp; the largest single motor being rated at 50 hp.

The meter department is in charge of one man, who also looks after inside trouble-work and does small repairing jobs, etc. A complete record is kept of the meter from the moment it enters the company's possession. The meters are read every month, and on complaint the trouble is investigated at once by the office force and if not adjusted an order is issued to read, examine or test the meter complained of.

The office of the company on East Main Street forms a part of the building and waiting-room of the Fonda, Johnstown & Gloversville Railroad Company. No showroom is maintained, the space available being only sufficient for bookkeeping departments, superintendent's and assistant's offices, and a small storeroom for incandescent lamps. In a short time the company expects to secure more commodious quarters on Main Street near the present office, where considerable room will be given to show purposes and for new-business work.

About three years ago a special solicitor was engaged to increase the load, the other employees and officials of the company also helping. The city was laid out in sections and each district thoroughly canvassed. As a further help the company advertised in the newspapers and trolley cars and distributed printed matter with the monthly bills. For a year the advertising matter of the Curtis company was used with good results. In two years the load was increased about 200 per cent. This was partly due to a low rate in effect at that time.

The rate for energy for lamps, signs and heating devices is 5 cents, less 10 per cent for prompt payment. The energy rate for motors is 3½ cents per kw-hour, with a discount of 5 per cent if the bill is paid within 10 days. Lower rates are given for large consumption. The minimum charge on all lighting installations is 50 cents per month. The minimum charge on the motor installations is $2 per month.

About three years ago the field at Amsterdam was entered by a water-power company and immediately the rates then obtaining for energy were lowered so as to hold the business and also to get new customers. The old base rate was 12 cents per kw-hour. Both companies suffered by rates too low for profitable business. The competing company is now in the hands of a receiver, and it is expected that in a short while the old schedule will be restored. The new-business work of the company was stopped during the financial depression, but will be started again very shortly with additional and renewed force.

The officials of the company are: President, Mr. William Harris; vice-president, Mr. S. H. Shotwell; secretary, Mr. G. M. Place; treasurer, Mr. L. K. Brown; manager, Mr. W. H. Collins, and superintendent, Mr. T. H. Pettengill.

Tungsten-Lamp Street-Lighting Results.

Mr. H. J. Gille presented a paper at the Minnesota Electrical Association convention at Minneapolis, March 19, on the use of tungsten lamps for street-lighting in which he gave figures on the life of lamps used in the installation on Nicollet Avenue, Minneapolis, described in the issue of July 19, 1908, page 141. He also called attention to the advantages of having brilliantly lighted down-town streets and offering suggestions to other companies in lighting their respective communities.

Benefits to City.

The prosperity of any city is in no way shown to so marked a degree as in the illumination effects which the city presents by night to the stranger. After the offices and commercial houses have closed for the day, leaving the business district quiet, is the time when the city is judged by the visitor, who usually stops at some hotel and goes out into the streets. Then it is that the progressive merchant shows his wares in the show-windows under the most favorable conditions and gains many a future patron otherwise beyond his reach.

The advantages gained by the city with distinctive decorative street illumination cannot be overestimated. It produces a cheerfulness at night and extends a welcome to the visitor. The system of artificial street illumination should be artistic as well by day as by night—not too spectacular, but dignified.

In Minneapolis the development of the ornamental street-lighting system was the result of the energy of the Publicity Club. The plan carried out was to have the property owners pay for the installation and the tenants pay for the maintenance. At this writing two streets have been equipped and the club is now working on a large extension of this system.

The tungsten lamp has made ornamental street-lighting possi-

ble on account of the greatly reduced cost—in fact, the cost with the carbon-filament lamp was almost prohibitive.

COST OF INSTALLATION.

In regard to the cost of installation and maintenance in Minneapolis, the cast-iron columns, complete with machine work, drilling and tapping, cost $85 per post delivered; erection, equipment and connections of post complete with five 100-watt tungsten lamps, $60 per post, making a total cost per post erected complete, $145.

COST OF OPERATION.

The Minneapolis General Electric Company operates these lamps for $78 per post per year. This includes energy, renewal of lamps, replacement of broken globes, repainting of posts once each year, cleaning globes at periodical intervals, and turning on and off. The lights on the four side-arms burn from dusk until 12 o'clock, and the lamp in the top globe from dusk to dawn each night.

LIFE OF TUNGSTEN LAMPS.

The lamps that are in use are General Electric, and are burned tip up. Records were kept on date of installation and removal of each lamp. In the first six months there were renewed 383 lamps. The average life of all burned-out lamps was 561 hours. If it is figured in the lamps of the original installation not burned out, of which there were 85, there is an average life of 725 hours. Of the original lamps not burned out there are seven center lamps which have burned an average of 2316 hours and 78 side lamps which have burned 1380 hours. It appears that the lamp used during the second three months was a better lamp than the first ones, as the company lost 223 lamps the first three months and 160 lamps during the last three months. The first three months the average life was 349 hours for lamps burned out, and the last three months 858 hours for lamps burned out. Adding the two together makes 561 hours, and adding the lamps not burned out of the original installation makes 725 hours. [Since this paper was written Mr. Gille informs us that the record for 246 days has become available, which shows the average life for all lamps for that period, including those not burned out, to be 780 hours. The lamps are bought for a potential of 2 volts higher than the circuit.—Eds.]

PROPOSED SYSTEM FOR OUTLYING STREETS.

In developing this system of street-lighting it may be interesting to state that the company is now working out ornamental street-lighting for the outlying districts with two 100-watt lamps on the post in the same position as on the side arms of those now in use. It hopes to be able to use a post that will cost considerably less money for the reason that a post can be designed for two lamps using 12-in. globes with the tip of the lamp up that will cost not to exceed $30, and with overhead connections the total expense of installation would be reduced to the minimum.

The system which is installed in Minneapolis at the present time is connected to the underground system and it is necessary to have patrolmen turn each individual post on and off. However, in the outlying districts, the company will endeavor to connect quite a number of posts on one circuit. In working out a system of illumination, especially for underground connections, it was found that the series system would be prohibitive for the reason that the cost of installation was very high. However, in the outlying districts it may be possible to work out the series system satisfactorily.

This system of illumination has great possibilities for the reason that it is the most satisfactory street illumination that has been devised up to the present. Its popularity is increasing and the tungsten lamp has made developments of this system possible on account of the efficiency of the lamps.

Electric Refrigeration in a Dairy.

By R. L. Lloyd.

An article on the subject of mechanical refrigeration printed several months ago in the *Creamery Journal* included among its other deductions the following statement: "To the man who can afford the first outlay, the modern compressor supplies by far the cheapest and handiest way of producing the refrigerating effect; the first cost shows a constantly diminishing tendency."

The prohibition put upon the use of chemical preservatives, the enforcement of the food laws, and the strict attention given to milk inspection, are making the milkmen much more particular than they were some years ago. That they are appreciating the advantages of mechanical refrigeration with electric motor-drive and central-station service is evident from the widespread introduction of the system.

An interesting case in this line is that of a dairy which handles 4000 qt. of milk per day and requires nine wagons for delivery purposes, where a refrigerating machine was installed three years ago. The machine is of the upright type, eight tons capacity, and is operated from a countershaft by a 15-hp motor. The dairy in question is illustrated in Fig. 1, and an enlarged view of the machine in Fig. 2. The machine is located in the rear of the dairy (Fig. 1), barely showing behind the workmen at the right. The motor is up above in the center, inverted on the ceiling, where it is well out of the wet and slop incident to this business. In the right foreground is the pasteurizer, after leaving which the milk is passed through the cooler, and the temperature quickly reduced to 40 deg., when it is bottled and stored in the refrigerator until delivered.

The cooler just mentioned is divided into an upper and a lower section. The upper section, which receives the warmest

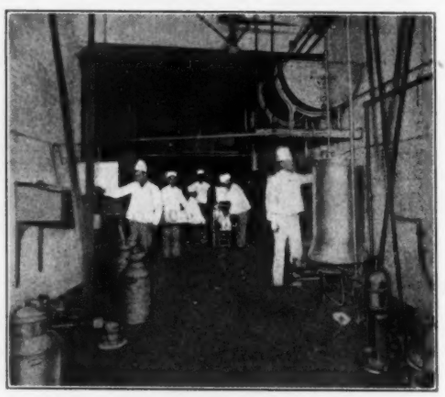


FIG. 1.—THE DAIRY.

milk, is cooled by water at 56 deg. from an artesian well. The lower portion carries refrigerated brine at a temperature of about 20 deg., which completes the rapid cooling of the pasteurized milk as it flows by gravity over the black tin tubes, within which the cold brine and water circulate.

The capacity of this pasteurizer is 60 40-qt. cans of milk per hour. About two hours are required for the pasteurizing and cooling of the day's supply. In round figures 100 cans of milk, each weighing 100 lb., or 10,000 lb. of liquid, must be cooled from 100 deg. to 40 deg. in two hours. This means that $10{,}000 \times 60 \times 0.9$ (specific heat of milk) $= 540{,}000$ lb.-Fahr. or b.t.u. must be removed from the milk in two hours, or 270,000 b.t.u. per hour. A refrigerating machine rated at 1 ton per 24-hour day utilizes 11,875 b.t.u. per hour; so that if direct expansion were used, and all this work were accomplished by the machine, there would be required a machine rated at over 22 tons on a 24-hour basis. The difficulty is overcome by the use of the brine, and the work required in one hour is accomplished with a smaller unit, spreading it over a period of three or four hours and storing it up in the brine tank.

To the left in Fig. 1 is seen the outside of the refrigerator box. This room is 26 ft. x 14 ft. and 8 ft. high, and is well insulated, with 11-in. walls. About 6 ft. of the rear end is partitioned off as a sort of freezer for the better keeping of cream. This section is cooled to 28 deg., while the main room is maintained at 32 deg. to 40 deg. The brine tank is located above this room and although entirely separated from it, is

really a part of the refrigerator box. It contains 2000 gal. of calcium chloride brine. Some of the expansion coils are immersed in this brine and some are on the inside walls of the room. The freezer carries 50 per cent more feet of pipe in proportion to the cubic capacity than the main room. Eight or ten hours' operation of the refrigerating machine in hot weather cools this mass of brine to 15 deg. Fahr. The brine is kept in motion by a small pump 12 or 15 hours out of every 24, except in winter weather when the outfit is not needed. This same pump circulates the brine through the cooler as above explained. Winter and summer operations differ to meet the varied conditions as found. When the temperature of the water from the city supply gets down to about 40 deg., as it will in Philadelphia around Christmas-time, this water is used and turned into both sections of the cooler and accomplishes the same result as the

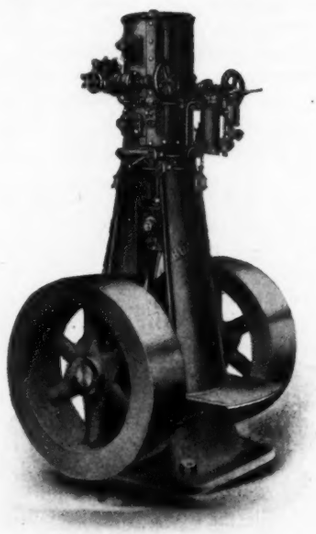


FIG. 2.—VERTICAL REFRIGERATING MACHINE.

well-water and brine, without expense for pumping or cooling.

This method achieves a very economical refrigerating system, as the table herewith shows:

Total kw-hours per year	16,391
Average kw-hours per month	1,366
Maximum kw-hours per month (July)	2,832
Minimum kw-hours per month (February)	000
Total kw-hours summer season (four months)	9,867
Total kw-hours winter season (four months)	576
Total yearly bill for electricity	$731.98

The ice necessary to cool the milk while on the delivery wagons is purchased during about 3½ or 4 months at regular market rates.

Some dairies have adopted the expedient of installing an ice-making plant to meet this need for ice. This is generally regarded, however, as a mistake. It increases the entire cost of refrigeration on account of the larger investment necessary and the additional space occupied, both of which are unproductive during the largest part of the year; and the electricity bills will usually be found to be higher, entirely out of proportion to the saving on ice bills. This might look like an argument against the installation of refrigerating machines, but it is not so. The making of ice and the production of refrigeration direct are two separate propositions. If everyone who wanted refrigeration must first make ice, small machines would never pay at the prices existing. There are losses at both ends—in making the ice and in recovering the refrigeration by melting. These are avoided by direct refrigeration. Then, too, the machine must be of double size when figured in ice making—that is, a 2-ton machine machine makes only 1 ton of ice and must be operated 24 hours per day to do it. Thus it is evident that where a 1-ton equivalent of refrigeration applied direct costs $1, one ton of ice to do the same work of cooling would cost $2 if made by the same apparatus.

Standards for Gas and Electric Light Service in Wisconsin.

Prof. Charles F. Burgess, of the University of Wisconsin, who is the expert on light and heat of the Railroad Commission of Wisconsin, read a paper before the Engineering Society of Wisconsin at Madison on Feb. 25, discussing the standards for gas and electric service prescribed by the commission.

Professor Burgess stated that in many respects the gas and electric utilities are similar, through the fact that they both supply to the public the means for securing light, heat and power. They are active rivals in developing markets for each of these three commodities, and this in turn means that these industries are progressing.

After referring to the competition between these two classes of utilities and to their development, Professor Burgess said that with these rapidly developing arts the establishment of standards is a difficult matter when it is desired that such standards shall not imply the enforcement of stationary conditions. The public has gained much through the progress of the gas and electric industries, not only by reduction in price, but more in the amount of service which can be obtained for a dollar, and much more may be expected in the future. There was, he said, comparatively little in the way of precedent to guide in the fixing of standards. In certain places there were municipal and other government rules referring to the accuracy of gas and electric meters. Similar standards were found for restrictions as to the purity of gas. In a few localities the heating value of gas was prescribed, and in most cases where regulation of gas was attempted the principal restriction was in reference to the "candle-power." A most important factor in the adequacy of gas service relates to the pressure, but in comparatively few instances had standards relating to pressure been adopted.

The principal factors affecting adequacy of electric service are uniformity of voltage, and lamp efficiencies. In reference to these, no standards were found other than those which have been voluntarily adopted by individual companies for their own use. It is obvious that standards which are satisfactory in one locality may not be satisfactory in another. This may come through a difference in conditions relating to the supply of raw materials, through density of population, etc.

Professor Burgess said that in the matter of regulation of electric pressures the public has as great, if not greater, interest than in the regulation of gas pressures. This is due to the fact that the greater proportion of electricity is used for illuminating purposes in the incandescent type of electric lamp, and in such lamps the efficiency of illumination varies in a much larger ratio than does the variation of voltage. A 10 per cent decrease in voltage may result in a 50 per cent decrease in light. A close approach to ideal conditions—that is, constancy of voltage—is physically possible, but it may involve such excessive expenditure as to be prohibitive on the part of the company and undesirable on the part of the public, and it is in recognition of this factor, together with the desire to establish a reasonable limit upon the voltage fluctuation that rule 23 prescribes a maximum variation of 6 per cent of the minimum value.

Prior to the adoption of the standards by the commission, a conference was called, to which were invited representatives of each of the utilities in this State, as well as representatives of the governing bodies under which these utilities operate. In addition to this, invitations were sent to some of the leading authorities outside of the State, including representatives of the National Bureau of Standards. At this meeting the various factors were discussed and the stenographic report constitutes a record on file in the offices of the Railroad Commission. Professor Burgess stated that when further investigation and future development show the desirability of changing any of the rules, it is the intention that such change shall be preceded by other hearings, at which those interested will be invited to take part.

As to the advantages of standards, Professor Burgess said that

the chief benefit is the insuring to the public of a reasonable and adequate service. That the public has gained much in this way has been abundantly demonstrated in the short time that the standards for gas and electric service have been in force in the State of Wisconsin. From a comparative study of the conditions before and subsequent to the decision of the commission on this matter, it is shown that there has been a marked improvement in the voltage regulation and in gas pressures, in uniformity of heating values, and less inaccuracy in meter registration.

It is, he said, a common, though erroneous, belief that discrimination between consumers is largely a matter of rate, but it can be shown that even greater discrimination may exist with rates on an equal basis, through errors in meters, through variation in gas pressures and electric voltages, through heating values of gas, and in efficiency of translating devices. Ninety-cent gas has little meaning unless the heating value of the gas is taken into account, and the people of one city who are pay-$1.25 for gas may, in fact, be getting cheaper service through better quality than a neighboring place where the price is $1. While the strict enforcement of the standards adopted cannot completely eliminate discrimination from the standpoint of service, the discrimination which is legalized is such as cannot be avoided under commercial and practical conditions.

Improvement in service has been brought about in some cases by the extension and remodeling of plant and equipment, but in many more cases improvement has been effected through closer study and decrease in the carelessness of operators, with little, if any, capital outlay. At the beginning of the investigation there were few gas and electric pressure-recording gages in use in this State outside of the city of Milwaukee, while at the present time liberal use is being made of such instruments.

Various secondary benefits have resulted. Complaints on the part of consumers and misunderstandings between the public and the utility companies have been greatly reduced. The gas and electric companies have themselves been benefited, since the rules which are consistent with good management cannot work to the disadvantage of any of them, and good management is forced upon certain companies who are short-sighted enough not to appreciate the commercial advantage to be derived through furnishing good service. Satisfactory standards cannot do otherwise than contribute to progress.

The existence of rules defining what constitutes efficient equipment is a safeguard for many of the smaller companies in purchasing meters and other similar equipment. Of all the mass of technical literature which the gas and electric manager has at his command, there is little, if any, of it in which is pointed out the weakness of existing apparatus. Each manager is compelled to learn the shortcomings of the apparatus found on the market through the school of experience, and in this process the public may frequently be made to suffer. The routine work of the inspectors in the employ of the Railroad Commission results in an accumulation of data from which conclusions as to the efficiency of various types of apparatus may be drawn, and this information is in a measure available to the managers of the plants operating in the State.

The enforcement of standards and the prohibition of the use of equipment which cannot meet the requirements of good service induce the manufacturer to pay special attention to improvement, and evidence has been brought forth to show that manufacturers are equally interested with the utility companies in working to standards, and to this extent are the manufacturers, managers and public brought into co-operative relations.

Professor Burgess stated that the inspectors in the employ of the Railroad Commission are chosen as men who have had technical training, who have had experience in plant management and operation, and who, by reason of such experience, supplemented by wider experience acquired in inspecting numerous plants in Wisconsin, are competent to give assistance to less experienced managers who are frequently found in charge of some of the smaller plants. It is by no means the purpose of the engineering staff to act in the capacity of consulting engineers for the companies, but, incidentally, the plants may secure certain useful information which might otherwise come only through the employment of outside expert service.

One of the important premises upon which the Wisconsin standards are based is that efficient and good business management shall not be interfered with. This is in recognition of the principle that really good management is that in which both public and company share alike in the prosperity of the business. It is in recognition of this principle that no specific regulations are laid down as to what lamp-renewal policy shall be pursued by each electric company. It is an unsettled question among electric authorities as to what method is really the best one, and the Wisconsin standards of service require only that some suitable system of making lamp renewals shall be put in force by each company, leaving it to the management to select that which, in its judgment, best meets the conditions. It is required that a description of this method be made public and be placed on file with the Railroad Commission.

With this information, and with the accumulation of data based upon the observations on the working out of the various systems, Professor Burgess said it was possible that more specific recommendations, and even rules, may be adopted at some future time.

The standards thus far adopted have for their purpose the securing of reasonable and adequate service, but it may be pointed out that this is not necessarily synonymous with satisfactory service, if by satisfactory service is meant that which produces satisfied customers. It has been an interesting observation that in certain cities where service may be considered as adequate, as judged by compliance with the standards, there is more complaint on service than in certain other cities where the service is much poorer, and this is due to a certain element in plant management which cannot be met by a standard—that is, the personal relations which may exist between the management and the public. Some companies are particularly successful in fostering a feeling of confidence and friendliness on the part of their consumers, while the management of other companies may be less fortunate and even neglectful of the commercial and other advantages which come through satisfied consumers. The only rule of the commission which touches upon this feature is that which requires gas companies to keep a record of complaints and to furnish a classified summary of such complaints to be submitted to the commission each month.

Whenever it happens that a gas or electric public utility makes a general reduction of rate of charge for service, the fact is usually given wide publicity through the press, but whenever a marked improvement in the quality of service is effected, which may mean much more to the consumers than does a small reduction in price, strange to say, this gain for the public does not appear to have general recognition. The public appears to be less appreciative of improved service than it is critical of defective service. Professor Burgess said that the record file in the engineering department of the commission has reached somewhat large proportions, and it contains many evidences of improvements which have been effected through the application of, or, at least, since the adoption of, the standards of service. These records show that instances of defective service have been pointed out to the utility companies and that many of such defects have been remedied. A great many more defects have been discovered by inspectors and remedied by the companies without even having been made a matter of record, and in very few cases have the companies showed unwillingness to comply with requests for improvements when practicable.

In addition to the regular routine work of inspection, additional work of a research nature is being planned and to a certain extent has already been undertaken. This research has to do particularly with matters which are of special interest from the standpoint of the public, such, for example, as the efficiency of gas water-heaters, the effect of variation of gas pressure upon efficiency burners, and the relative advantages of different methods of street illumination. In carrying out work of this nature the engineering staff is receiving assistance from various laboratories of the University of Wisconsin.

INTERIOR WIRING AND ILLUMINATION

Practical Photometry.

We have published recently several important articles dealing with standards of light and their relations, and with various phases of the present illuminating situation. As a whole, these various studies leave the impression that the subject of light and its measurement is in a rather undetermined and unsatisfactory state. So, indeed, it is from the standpoint of pure theory or of systematic philosophy, yet the case is not so bad practically as at first sight it would seem. Even as regards standards one need not sink into despair. True, there is no primary standard of a precision comparable with the standards of length and mass, and improvement in this respect is greatly to be desired; yet as a matter of fact the working standards in the form of incandescent lamps can be trusted down to the limits of precision in photometry, and that is farther than actual commercial measurements are likely to go for some time to come. A group of standard lamps compared, like the international standards of length, at one place, and distributed to the various nations undertaking to abide by them, could be trusted to hold the working unit intact for all commercial purposes for years—long enough to allow the development of a first-class primary standard to carry on the work. So long as a meter stick is exact, well within the limits of precision feasible in its required use, it is a pretty good practical meter stick, irrespective of its precise relation to the earth's quadrant or wave length of light. When the outstanding discrepancy with respect to the so-called standard candle is settled or compromised by agreement, as is soon likely to be the case, it will be at once possible to have working standards agreeing among themselves with an exactness far within the errors that must be expected in first-class commercial photometry. Photometry at best is not a process of the highest precision, yet it is fairly comparable with the work of the ordinary run of commercial electric measuring instruments like voltmeters and ammeters, and is considerably better in exactness than the commercial meters by which the raw material of lighting is sold.

Hence, pending a long research on primary standards it is possible to have secondary standards of intensity that in the practical commercial sense are thoroughly efficient for the purpose in hand. The chief step that needs to be taken is the general acceptance of such secondary standards and a working agreement as to the terms of the comparisons with them. Our canonical standard of intensity is referred to the mean horizontal value while, as a matter of fact, commercial illuminants depend for their practical value on the total flux of light in all directions. It is now quite easy to determine by means of the sphere photometer the mean spherical "candle-power" of a source by direct reference to the working standards, so that we have at once available a consistent measure of light flux for commercial purposes—accurate, certainly, within the commercial measurements of the light-giving stuff sold. Until commercial meters are more accurate than photometers, one need not worry much about the residual errors, though, of course, every effort should be made to reduce them. The immediate practical need is a general agreement on the mean spherical candle-power which is proportional to the total light flux, instead of the shiftless scheme of evaluating only such part of the flux as is convenient for imposing upon the ignorant. Until there is agreement upon so simple a matter as this, further refinements are farcical. One can go a long ways in practical illuminating engineering without complicating the issue further. When it comes to the determination of illumination in situ, experimental work is complicated by the existence of a plurality of sources which, while the sum of their effects can be measured or, for that matter, calculated under certain fixed assumptions, remain of somewhat indeterminate relative utility. For example, there is not yet general agreement as to whether street illumination should be reckoned by the normal or the projected components of the light, and in interior work a similar discrepancy is introduced by the practical difference in utility of light from several sources. Such purely practical questions as are here involved are in the commercial sense vastly more important than the residual errors of photometry or the discussion of new units and nomenclature.

Another matter of very great and immediate importance is settling a basis, if only a temporary one, for color photometry. Modern illuminants run through a wide gamut of hues, and as yet satisfactory comparisons are undeniably troublesome, at least as regards the extremes. Here is a vital matter that needs thorough investigation. At present it is a constant source of contention. Until some of these fundamental matters are cleared up, it seems to us impracticable to reduce illumination to anything which approaches an exact science, or to clothe it in the garments of precise terminology. The unwillingness of even technical writers to fall in with an excellent system of units devised now a dozen years since, has been deplored, but from one point of view it is much better to hold it in abeyance for a while than to try to force it into use before the art has advanced far enough to utilize it intelligently. It is on record, and being consistent is not likely to be replaced by anything radically different. It holds the field, so to speak, until such time as practice gets within hailing distance of it. When that time comes—the time when scientific illumination has emerged from the present state of uncertainty—useful terms will slip from the pen naturally enough. For the present there is much work at hand merely to arrive at a general working agreement about fundamentals, the establishment of working standards, the settling of most points about methods of measurement and the determination of really fundamental physical relations. For such work the way is already clear and the main thing is to pursue it without wandering off into a quagmire in pursuit of theoretical will-o'-the-wisps. There is nothing more intensely practical in its ends than illuminating engineering, and while it chances to involve a great mass of intricate theory that must eventually be worked out, the vital issues for the time being are broad ones bearing directly upon every-day commercial work. The data and methods now at hand, while not ideal, are good enough to insure vast progress in the art when they are intelligently applied. It is a time for the illuminating engineers to get busy and get together—to produce the best results possible from the material at hand. It is the poor workman who quarrels most with his tools.

The Use of Tungsten Lamps from the Illuminating Engineering Standpoint.

In a paper presented at the recent convention of the Minnesota Electrical Association Convention, Mr. J. R. Cravath discussed the tungsten lamp from the illuminating engineering standpoint. Tungsten lamps, he said, require different treatment from ordinary incandescent lamps because of their greater size of bulb, higher candle-power and higher intrinsic brilliancy of the filaments. We commonly find tungsten lamps of 48 cp and 80 cp in use where carbon-filament lamps of only 16 cp or 32 cp were before used. This means an increased amount of light, but if the illumination is to be comfortable to the users, as well as efficient in its most practical sense, the direct light from the filament must be shaded, not only because of its effect on the eye, but because, as will be explained later, it is usually necessary for reasons of reflection efficiency.

If we are to use tungsten lamps efficiently, so as to meet competition of various kinds, we must study the points likely to cause loss of efficiency in connection with the various ways that tungsten lamps can be used. He uses the word "efficiency" in this sense as referring not only to the actual illumination in foot-candles delivered where we most wish it as measured by a portable photometer, but also to the various physiological and psychological effects which go to make up

our judgment as to whether there is ample and sufficient illumination in a room. In other words, he used the term "illuminating efficiency" as referring to that which enables us to see clearly and to best advantage the things we most wish to illuminate. To obtain efficiency in this sense we must not only provide for efficiently reflecting or directing the light to places where it is most needed, but we must also consider the effect of the lamps themselves on the eye. Other things being equal, that room will appear best illuminated which has the light sources most completely shaded from the eye. This is for the reason that a bright light has two effects on the eye which interfere with the clearness with which we see surrounding objects. One of these effects, the oculists tell us, is that a bright light entering the retina of the eye reduces the sensitiveness of the retina to surrounding objects. The nerves appear to concentrate their attention on the light to the partial exclusion of surrounding objects. The other effect, which is slower in its action, is that the pupils of the eyes automatically contract in the presence of a bright light in order to protect the retina. Less light is admitted to the eye, and thus objects in a room with very brilliant light sources are apparently not so well illuminated as they would appear to be if the pupils were allowed a wider opening.

If we hang a bare incandescent lamp pendant in a room, a large proportion of the light of such a lamp is given off at angles near the horizontal. This light strikes the walls of the room at such angles as to be reflected back and forth between the walls and ceilings many times before reaching the plane we most wish to illuminate. Thus there is much loss by absorption on the walls and ceilings, as each reflection involves some loss of light.

We therefore have as a fundamental principle that efficient illumination can only be accomplished where the light reaches the working plane with but few reflections. Any scheme which permits a large amount of the light of a lamp to be given off horizontally without being intercepted by a reflector is sure to be wasteful, because such light does not reach the working plane directly or even after one or two reflections, but must be reflected back and forth many times before the light reaches the plane with the illumination of which we are most concerned.

There are two methods of securing good results in the use of tungsten lamps, both of which are being extensively used at the present time. Both involve the use of correctly designed, deep reflectors which intercept the large flux of light given off in horizontal directions and direct it in such a way that it can be efficiently utilized.

The method with which we are most familiar may be termed the direct-lighting system, in which a considerable percentage of the light is obtained directly from the lamp and the reflector placed over it. In this system, as applied to the general lighting of rooms, the lamps are placed pendant, equipped with deep reflectors. These deep reflectors, if scientifically designed, reflect from 55 to 75 per cent of the light downward at angles below 75 deg. from the vertical. They also shade the direct light of the filament from the eye, except at the tip of the lamp, which should be frosted. The general lighting of a room by this plan must be accomplished with translucent reflectors; that is, reflectors which allow part of the light to pass through to illuminate the ceilings and sidewalls.

There are four types of translucent reflector on the market for use with tungsten lamps at the present time: Prismatic reflectors, clear, enameled and frosted, as made by the Holophane Company; plain opal reflectors, as made by the Phoenix Glass Company and by Gillender & Sons; sand-blasted or frosted reflectors, as made by the last two companies, and "Opalux," a modification of opal, supplied in the West by the Central Electric Company. The sand-blasted reflectors, of course, allow more light to pass through and reflect less than the opal or prismatic. The amount that passes through an opal reflector is so dependent on the density of the opal that no general rule can at present be given as to relative performance of the opal and prismatic types. As a general principle, however, similar shapes of opal and prismatic reflectors give similar light distribution.

Enough has been said so far about the importance of having reflectors completely cover the lamps so that we hardly need repeat that any shallow or flat reflector which exposes a large portion of the lamp filament is not only inefficient, because it allows a large flux of light to escape horizontally, but also produces bad illuminating results because of the blinding effect the lamp is likely to have on the eyes of those in the room. In many cases it would be better to leave off the reflectors entirely than to use small and shallow ones. A flat reflector tends to darken the ceiling and allows excessive light to go to the side walls. This darkening of the ceiling with excessive sidewall illumination adds to the glaring, blinding effect. In some cases glare is the only thing that will satisfy a customer, but our efforts should be in the opposite direction. We are all doubtless experiencing difficulty in the smaller towns in persuading our central-station customers to invest the few cents necessary for shades and reflectors to cover tungsten lamps. This is especially true in the small towns, where rows of bare lamps hung on drop cords have heretofore been the rule for store lighting. The drop cord in itself is excellent for supporting tungsten lamps, but it is best the lamp be hung high and that it be used with a deep reflector.

A second method of lighting which has attracted considerable attention from time to time is the indirect system, in which the lamp is concealed and the light is obtained by reflection from a light-colored ceiling. In this system the same principles as laid down in connection with reflectors for direct lighting apply. To secure efficiency, a large percentage of the light must be directed upward to the central part of the ceiling if the room is small in order that the rays reflected from the ceiling may strike directly the central part of the room which we wish most to illuminate. The reflector should, therefore, be deep and of correct design, just as that used in direct lighting. The efficiency of this system is less than that of a good direct system by 33 per cent or more. However, as compared with an inefficient direct system, its efficiency may be higher. Take a direct system in which considerable light may be allowed to escape sidewise and in which the lamp is equipped with an enclosing globe of diffusing glassware, which in itself absorbs considerable light. In such a case the efficiency of the direct system may be even lower than that of a correctly designed indirect system. The efficiency of the tungsten lamp has opened up the indirect lighting field in a way that it has not been opened before. It is certainly a very comfortable method of illumination. If it is to be efficient, it is evident that the ceiling must be of very light tint, that the reflector used for directing the light to the ceiling be of high efficiency, and that the user thoroughly understands the importance of frequent cleaning, since the reflector and lamp are hidden and likely to go unnoticed. Indirect lighting manifestly calls for an opaque reflector, unless it is to be only partially indirect. Of the opaque reflectors, those with mirror coatings, such as the X-ray, Frink and others, give the highest efficiency. White enamel, metal, polished metal and aluminum are considerably lower than the mirror in reflecting efficiency. There is, however, considerable difference in the life and the efficiency of different kinds of mirror coatings. Some of them are notably short-lived and unable to withstand the heat of the lamp.

It is evident that we may employ a combination of direct and indirect lighting. In fact, most of our so-called direct lighting is really a combination of the two methods, because part of the light is received direct from the lamps and reflectors and part by reflection from the ceiling and walls. We can reduce shadows considerably by increasing the amount of indirect lighting with translucent reflectors, by turning these reflectors upside-down and pointing them toward the ceiling. This gives some of the effects of an indirect-lighted room, but retains the disadvantage of more or less exposed sources of light and still causes shadows sufficiently sharp to be somewhat annoying. One of the practical advantages of indirect lighting by reflection

from the ceiling with the sources of light entirely concealed is that it is not necessary to pay so much attention to shadows as in direct-lighting systems.

Another combination of direct and indirect lighting which, in the writer's opinion, is to have a field of considerable usefulness, is a system wherein the general lighting is by the indirect method, with lamps concealed behind opaque reflectors, this general lighting to be supplemented at points where specially high illumination is needed by completely shaded lamps, equipped with opaque reflectors. This does away with all the annoyance caused by exposed lamps and produces excellent results at reasonable cost. How great this annoyance of exposed lamps is can only be realized by one who has used for some time a system in which no lamps are exposed.

None of the systems enumerated is to have any monopoly of the field in the future. Each will have its proper place.

Electric Signs on Atlantic City's Board Walk.

The name Atlantic City is inseparably connected with the famous Board Walk which skirts the ocean front, and is continuous from the Inlet to beyond the city limits, a distance of

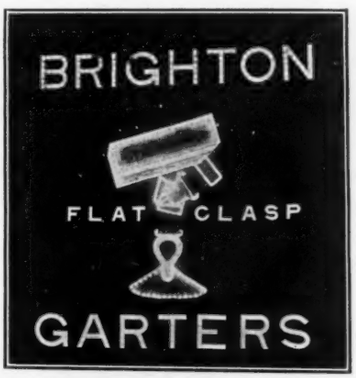


FIG. 1.—ELECTRIC SIGN.

over five miles. The walk varies in width from 20 ft. to 60 ft., and is a rendezvous for fully 80 per cent of the people visiting and residing at this all-the-year-round resort. The commercial possibilities of the walk for advertising purposes have not been overlooked by what are known as general or national

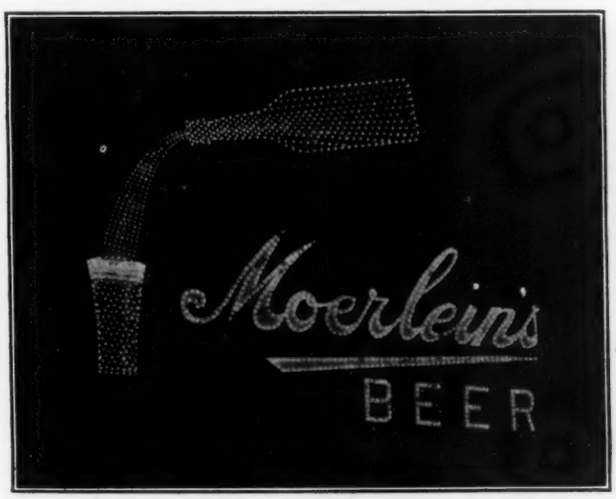


FIG. 2.—ANIMATED ELECTRIC SIGN.

advertisers. As a consequence the walk possesses a large number of electric signs, some of which are of the animated type, and all of which are large. Without exception, the signs which are of the individual-letter, skeleton type, erected on angle-iron framework, well braced to withstand the raging storms which sometimes sweep in from the Atlantic, are located on the roofs of the houses which line one side of the walk.

During the winter some of the signs are discontinued, but

FIG. 3.—SIGN WITH VARI-COLORED LAMPS.

in the spring, when the regular season opens, and the promenaders become more numerous, the electric signs come into prominence again. The accompanying illustrations show a number of the large signs now in operation. The sign shown in Fig. 2 is one of the most attractive on the walk, chiefly because it is animated. It is located below Maryland Avenue, and faces the Steel Pier. About 1500 lamps are used in its make-up; those within the bottle and glass outline, as well as those within the stream issuing from the mouth of the bottle, being connected on a flasher. The lamps are lighted and extinguished in such sequence that a flowing effect is produced, the bottle emptying and the glass becoming fuller and fuller.

The sign shown in Fig. 1 is located at the corner of Pennsylvania Avenue, and faces toward the Steel Pier. It contains 600 lamps; the garter being outlined in red, and the clasp in white, the other lamps being white. Below Young's Pier at the corner of St. James Place is the sign shown in Fig. 3. This faces south along the Board Walk, and contains 1500 lamps of various colors. The diamond-shaped decorations, chain and bracket are studded with green lamps, the ovals with red lamps and the legend with white lamps. Like the sign shown in

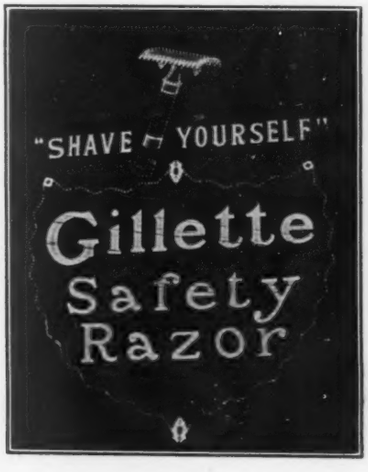


FIG. 4.—LARGE ELECTRIC SIGN.

Fig. 1, the lamps burn steadily. Fig. 4 shows a sign at the corner of Kentucky Avenue, facing up the Board Walk toward the piers. The razor handle is outlined in red, the border is studded with red and green lamps, and white lamps are used

in the rest of the design. The number of lamps in the sign is 1500.

Above Kentucky Avenue, facing toward the south, is the sign shown in Fig. 5. This contains 1150 multi-colored lamps, and is quite effective. Below Missouri Avenue, facing Young's

FIG. 5.—ELECTRIC SIGN.

Million-Dollar Pier, is the immense sign shown in Fig. 6. This measures 60 ft. x 90 ft., and contains 3300 lamps. The border, which represents a fancy frame, is made up of vari-colored lamps, and the name is outlined in white lamps. The sign

FIG. 6.—IMMENSE ELECTRIC SIGN ON FLASHER.

stands silhouetted against the black sky, and can be seen from great distances. To add to its effectiveness the name is flashed. The energy for all of the signs is supplied from the mains of the Atlantic City Electric Company.

Letter to the Editors.

A Much-Needed Investigation.

To the Editors of Electrical World:

Sirs:—The determination of the proper size of rail-bond to be used in any installation is almost invariably performed in one of the following irrational ways:

(1) By making the conductivity of the bond metal equal to that of the rail; (2) by asking the advice of the manufacturers; (3) by doing what other people have done in similar cases; (4) by guessing.

The writer, having seen all of these methods employed with indifferent success in various installations, attempted the following system:

1. Determining the current which the bond will have to carry continuously and for short intervals, and selecting a size of conductor which will accomplish this without overheating.

2. Assuming perfect contact at the terminals, calculating the bonding efficiency of the line with a bond of the size selected above. If the conductance of the line is, say, 90 per cent of what it would be with continuous rails, this size is ample, if the conductance is less than, say, 90 per cent, the size should be increased. It should be noted that the bonds constitute such a small proportion of the line that even if of low conductivity the whole line may still have a high average conductivity. The bonding efficiency, E, of a line is given by the following formula, in which

k = average efficiency of bond
L_1 = length of rail
L_2 = length of bond

$$E = \frac{L_1}{L_1 + \frac{L_2}{k}(1-k)}$$

Thus, if the bond is 2 ft. long and has an area of 500,000 circ. mils, and the equivalent copper area of the rail is 1,000,000 circ. mils,

$$k = \frac{500{,}000}{1{,}000{,}000} = 0.5$$

$$E = \frac{30}{30 + \frac{2}{0.5}(1-0.5)}$$

The resistance of the joint is neglected, as any size terminal may be used for any size wire.

3. The mechanical conditions are investigated, and if the size determined by electrical considerations is not great enough to meet the mechanical requirements, it must be correspondingly increased.

The writer's attempts to work on this basis were frustrated at the very start through the impossibility of obtaining data on the carrying capacity of bonds, especially for currents of short duration. The steady carrying capacity is seldom of use, as on the average railway the current is intermittent. An investigation of the literature issued by the bond manufacturers, of the handbooks, textbooks and files of *Science Abstracts*, and correspondence with various people led to the conclusion that the subject has not been investigated.

The writer suggests that those in charge of college laboratories who may feel inclined to add to our useful store of knowledge can do so by investigating the short-period carrying capacity of various types of rail bond under working conditions and publishing the results for the benefit of the electrical profession.

The fact that the bond manufacturers do not supply this information is a striking commentary on the way some of them do business. Imagine a shoemaker who couldn't tell the size of his product and made his customers buy shoes either by matching the size of their gloves, by asking the advice of the manufacturer, by the size that other people wear, or by guessing! Yet, is this not what the bond manufacturers are doing?

New York. William A. Del Mar.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Three-Phase Induction Motors.—W. Rogowski and K. Simons.—In a former paper the authors have shown that the usual calculation of stray fluxes must be modified and that for the case of transformers and alternating-current commutator motors it is advisable to introduce the conception of the "mutual coil factor." In the present paper the authors solve the same problem for induction motors. They give new rules for calculating and measuring the stray fluxes for three-phase induction motors. The paper is to be concluded.—*Elek. Zeit.*, March 11.

Flywheel Load-Equalizing Sets.—T. E. Robertson and F. Holden.—A note on a recent British patent (3284, 1908; March 4, 1909) of the British Thomson-Houston Company. Two arrangements are described. In the first a motor-generator is mounted on the same shaft with a flywheel and an auxiliary machine with opposing shunt and series windings. The series winding and the armature of this machine are in series with the armature of the motor. When the load comes on the auxiliary machine is caused to generate and to reduce the pressure across the motor terminals so that the speed of the whole set can drop, and the flywheel give up its energy, without the motor current increasing. In the alternative arrangement the auxiliary machine is mounted on a separate shaft with its own flywheel and speeds up and thereby reduces the pressure across the motor terminals when the load comes on, its series winding in this case being in series with the load.—Lond. *Elec. Eng'ing*, March 11.

Compensated Auto-Transformer.—A note on a recent British patent (28,652, 1907; Feb. 25, 1909) of H. M. Hobart, F. B. Cramer and E. Coad. This is a combination of an auto-transformer and an ordinary transformer, a few secondary turns of the transformer being connected in series with each section of the auto-transformer. The voltage drop in any one circuit, due to the loading of any other, in the case of the transformer, is equal and opposite to that in the case of the auto-transformer. Thus the pressure across any one section of the combined transformer will be unaltered by change of load on any other section; the pressure across each section will vary with the load on that section.—Lond. *Elec. Eng'ing*, March 4.

Linseed Oil.—A note on the dangers of linseed oil in the construction of dynamos, etc. Linseed oil is a commercial commodity on account of the rapidity, as compared with other oils, with which it absorbs oxygen; but, since no means are available for arresting the oxidation at any given point, this characteristic becomes a positive danger as regards electrical work. With proceeding oxidation there is liability of the formation of a brittle powder which rapidly absorbs moisture to the detriment of the insulation.—Lond. *Elec. Rev.*, March 5.

Electric Ignition.—J. Loewy.—The first part of an illustrated paper on the electric ignition of gas engines for automobiles and for stationary purposes.—*Elek. Zeit.*, Feb. 25.

Lamps and Lighting.

Radiation Constants of Metals.—W. W. Coblentz.—In Wien's radiation law,

$$E = c_1 \lambda^{-a} e^{-c_2/\lambda T}$$

E is the radiation with wave-length λ at the absolute temperature T, and c_1 and c_2 are two constants, while a is the so-called "radiation constant." It has a value of 5 for a "black body" and 6 for platinum. The author has determined the same constant for different metals used in the new metallic-filament lamps. He has also determined the energy curves for various filaments. One method in demonstrating the great difference in the emissivity in the infra-red as compared with the visible spectrum, due to the difference in the value of a, is to set the various filaments to the same intensity in the visible spectrum and observe the difference of their energy curves in the infra-red. These curves are given in Fig. 1 for carbon, tungsten and osmium. A glance at the figure shows that the carbon lamps emit about one-third more infra-red energy than the metal filaments for the some radiation in the visible spectrum. This alone is sufficient to explain the higher efficiency of the latter, without introducing the question of a selective emission in the visible, the term "selective emission" being used to indicate an abrupt change in the energy flow curve with change in wave-length. The results of the investigation of the author show that the so-called radiation constant a of all the metals examined is higher than that of platinum at the same temperature. Osmium seems to have the highest value $a = 7$. Contrary to the results of previous investigations, the present work shows that the so-called "radiation constant" a decreases

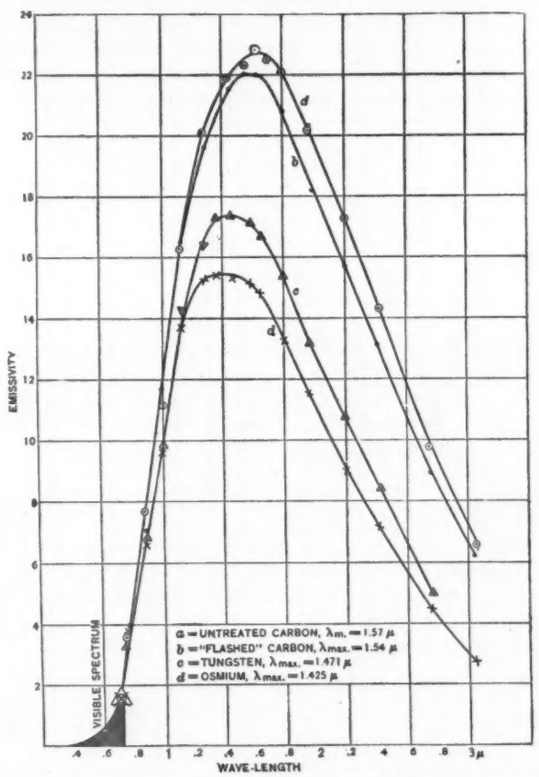

EMISSIVITY
WAVE-LENGTH
VISIBLE SPECTRUM
a = UNTREATED CARBON, λm. = 1.57 μ
b = "FLASHED" CARBON, λmax. = 1.54 μ
c = TUNGSTEN, λmax. = 1.471 μ
d = OSMIUM, λmax. = 1.425 μ

FIG. 1.—SPECTRAL RADIATION CURVES.

uniformly with rise in temperature; that is, a has a temperature coefficient probably similar to that of electrical resistance. Theoretically, this decrease must occur, but whether the change takes place abruptly or whether it is a gradual change remains undetermined. It is, therefore, an open question whether or not there is a "radiation constant" a for metals. This fact is of vital importance in the application of optical pyrometers,

Lamp filament.	λ max.	Temp.	Constant. a.
"Metallized" carbon	1.423	1570° C.	6.1
Tantalum	1.344	1670	6.3
Tungsten	1.257	1810	6.6
Osmium (55-volt lamp on 50 volts)	1.401	1600	6.9

although the "optical constants" of the metals show no appreciable temperature coefficient in the visible spectrum. The accompanying table gives approximate values of the "constant" a of four metals as used in the 110-volt lamps investigated when under "normal operation." The "normal" operating temperatures, computed on the assumption that the con-

stants are the same as for platinum, are given in the third column of this table. The values, of course, are only approximations, and are all much lower—from 300 deg. to 500 deg. less—than found by Waidner and Burgess, using an optical pyrometer. This is, of course, due in part to the assumption made that these metals have the same constants as platinum, which is contrary to observation.—*Bull. Bureau of Standards*, Vol. 5, No. 3, February.

Efficiency in Illumination.—A. J. Sweet.—The author gives a diagram, reproduced in Fig. 2, in which is shown the relation which the renewal cost of the lamp bears to the cost of energy at different costs per kw-hours. The curves apply to the 16-cp, 3.1 watts per candle, 110-volt carbon-filament lamp. Curve *A* represents the renewal cost, expressed as a percentage of the total cost of operation, including renewal. Curve *B* represents energy consumption cost, likewise expressed as a percentage of the total cost. Within the range of cost at which electrical energy is commonly available to the user of light—from 8 cents to 15 cents per kw-hour—the renewal cost is almost negligible as compared to the cost of energy. If a less efficient lamp had been taken as an example, the life of the lamp would have appeared as a still less important factor. Efficiency of illumination is really the combined effect of three different kinds of efficiencies. First, there is the efficiency of visual perception, this being the efficiency with which the eye receives light energy and transforms it into visual perception. Second, there is

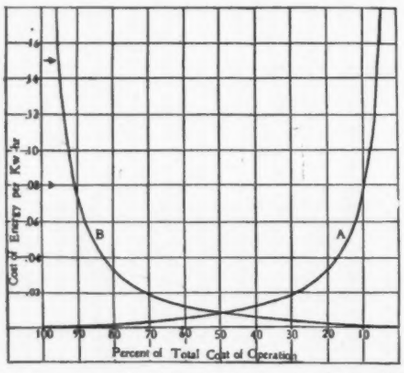


FIG. 2.—RELATION OF RENEWAL COST AND ENERGY CONSUMPTION.

the efficiency of light distribution, by which is meant the relation between total light energy generated and light energy useful in producing desired conditions for visual perception. Third, there is the efficiency of the light source, by which is meant the efficiency with which chemical or electrical energy

Kind of lamp.	Mean Spherical cp.	Watts, per cp.	Number of cp per kw.
Common 56-watt carbon-filament incandescent lamp, rated at 3.5 watts per candle, 16 horizontal candle-power	13.2	4.24	236
Common 50-watt carbon-filament incandescent lamp, rated at 3.1 watts per candle, 16 horizontal candle-power	13.2	3.78	264
Three-glower 264-watt Nernst lamp	81	3.26	307
"Gem" 125-watt graphitized-carbon-filament lamp of 60 horizontal candle-power	40.7	3.67	326
44-watt tantalum lamp, 22 rated, horizontal candle-power	16	2.75	364
Direct-current 5.1-amp enclosed arc on 110-volt circuit, 0.5 in. carbons	213	2.63	380
Alternating-current enclosed 5.7-amp arc, taking 388 watts on 110-volt circuit, 0.5-in. carbons	152	2.55	392
Tungsten 60-watt, 1.25 watts per candle, 110-volt lamp	37	1.62	641
Luminous 8-amp arc, 440 watts, two in series on 110-volt circuit	1,020	0.431	2,320

is transformed into light energy. Each of these factors is of importance in determining the resultant efficiency of illumination. Efficiency of visual perception depends upon three conditions. These are: (a) the intrinsic brilliancy of the light source and of the surrounding light-reflecting objects; (b) the color of the light, and (c) the intensity and steadiness of the light. Each of these conditions is briefly considered in turn. Efficiency in light distribution depends upon two important factors, namely, the distribution of light which emanates from the illuminating unit, and the size of the unit and the location of centers of light distribution. The amount of light which is reflected from differently colored paper is 80 per cent from white paper, 50 from orange, 40 from yellow, 35 from light pink, 25 from light blue, 18 from emerald green and 10 from dark-brown paper. As to the use of shades and globes, the author remarks that a correct distribution of light about the illuminating unit is an indispensable condition to efficient illumination and low cost of operation. No light source now on the market gives of itself correct distribution. Hence, suitable glassware to modify and correct the distribution should invariably be used. The problem of correct distribution and proper means of obtaining it is a highly technical problem to be solved only by a competent illuminating engineer. The author finally compares the efficiency of different sources of light and shows that on the basis of the radiation laws the efficiency of an incandescent lamp increases with the temperature of the filament. The following summary of various electric lamps is given in the accompanying table. The candle-power always means spherical candle-power.—*Elec. Jour.*, March.

Tungsten Lamp.—A note on a recent British patent (3388, 1908; March 4, 1909) by J. W. Howell for a method of making joints between tungsten lamps and leading-in wires. The end of the nickel wire is bent into a hook, and the end of the filament, previously coated with a paste of finely divided tungsten or copper mixed with gum arabic, is placed in the hook. An arc is drawn from the extreme end of the hook and a globule of fused metal runs into the corner of the hook, thereby fusing the paste and filament together. A portion of the coating above the joint is merely hardened and appears to prevent the filament from breaking at the joint. The joint can be also made by heating the hook to a white heat.—Lond. *Elec. Eng'ing*, March 11.

Electric Hand Lamps.—W. Vogel.—The conclusion of his illustrated description of various modern types of portable electric hand lamps. Older hand lamps often had metallic parts on the outside, so that when something within the lamp got out of order the outer metallic parts were liable to become charged. Such cases have even resulted in fatal accidents. In the construction of the modern types of lamps such accidents have been rendered impossible. However, the reliability of operation does depend not merely on the construction of the lamps themselves, but also on the conducting wires. It is very important to keep them always in good condition.—*Elek. Zeit.*, March 11.

Generation, Transmission and Distribution.

Limits of Energy Transmission.—A. M. Taylor.—A paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. The object is to draw attention to certain possibilities in the way of commercial developments that, as far as the author is aware, have been somewhat overlooked. The author's proposal is that electrical storage on a large scale should be carried out at the distributing centers, the reliability of the line being thereby increased to an extent that would warrant a second line being dispensed with. At the same time a case for storage batteries can be made out on other grounds. Such fixed charges as wages, management, taxes, water-power purchase, rights, etc., are all reduced with the reduction in the size of the generating station and line, and these would, of themselves, the author estimates, alone more than pay for the cost of maintenance of batteries and auxiliaries.—Lond. *Electrician*, March 12.

Smoke Abatement by the Distribution of Electrical Energy.—S. E. Fedden.—A note on a paper read at the recent Smoke Abatement Exhibition in Sheffield. The author urged that the supply of electrical energy is doing much to reduce the amount of smoke in towns. The rate of progress of energy supply by the Sheffield municipal electricity works is of interest in this connection. In 1902 the department had only 527 hp of motors connected to its mains; in 1905, 3617 hp; in 1907, 7004 hp, and this year no less than 12,000 hp of motors are connected, the amount of energy sold for motors now ex-

ceeding that sold for lamps. The coal consumption at the Neepsend generating station is equivalent to from 2.5 lb. to 3 lb. per hp-hour sold, whereas the private plants displaced consumed on an average about 10 lb. of coal per hp-hour, so that a considerable saving of coal is taking place, in addition to the fact that the coal at the large station is being burned under conditions making for smokelessness.—Lond. *Electrician,* March 12.

Yorkshire Boiler.—W. H. Casmey.—A paper read before the Halifax Engineers and Firemen's Association, discussing the construction and the advantages of the Yorkshire boiler. The advantages of the Yorkshire boiler over any other of the cylindrical type are stated as follows: Higher efficiency and evaporation, lower cost and less ground area and brickwork, conduction and radiation losses one-third less than in the Lancashire boiler for the same evaporation. The boiler is absolutely fool-proof; that is, it is quite impossible for a crown plate to come down owing to the expanded flues, because the fusible plugs are at the back end of the boiler. The boiler is shorter and distributes the heat and water proportionately, the expansion and contraction will be much less, cross-strains are avoided and the life of the boiler will consequently be a long one.—Lond. *Electrician,* March 12.

Motors with Controllers Attached.—An illustrated description of a three-phase motor fitted with slip-ring rotor and short-circuiting device, of German make, which is started by a hand-wheel. The starting device consists of a controller mounted on an angle-iron frame and is bolted to the motor feet and fitted to the original terminal board of the otherwise unchanged standard motor. The case of the starter also contains the necessary starting resistors, in addition to the controller drum, which is operated by the hand-wheel. Both are immersed in oil, by which means the desired small dimensions together with good insulation and sufficient cooling, are attained. The lifting of the brushes after the short-circuiting of the slip-rings has taken place is effected by means of a level, connected to the hand-wheel of the controller.—Lond. *Electrician,* March 12.

Electric Pumps.—D. E. Carpenter.—In a continuation of his illustrated serial on the application of automatic controllers to direct-current motors, the author discusses the control of pump motors. He describes the float type and the pressure type of master switch.—*Elec. Jour.,* March.

Gas Power.—An illustrated description of the gas-driven blowing plant of the Indiana Steel Company, and the mechanical and operative features of blowing house No. 3, at Gary, Ind.—*Elec. Jour.,* March.

Traction.

Speed Control on Electric Railways.—P. Dawson.—A continuation of his very long illustrated serial on electric traction on railways. In this instalment the author describes three types of multiple-unit control, namely, the electromagnetic shunt system, the electropneumatic system, and the electromagnetic system developed by Dick, Kerr & Company, in which the return current from the motors operates the contactors. Car wiring is next discussed and, finally, the safeguards and methods of installation required in connection with the use of high-tension apparatus.—Lond. *Electrician,* March 12.

Trackless Trolley Cars.—A description of a system of omnibuses which are run on ordinary roads without rails, but receive current from overhead wires. In a system of this kind, which is used to a considerable extent in Austria, the electric motors are made part of the wheels. The omnibuses are of light weight and can run on narrow roads and can easily move to one side so as to let other carriages pass. The cost of operation per kilometer—including electric energy, maintenance, taxes, wages, etc.—is said to be from 4 to 6 cents. The capacity of the omnibuses is 24 passengers.—*Elek. Zeit.,* March 11.

Installations, Systems and Appliances.

Leeds.—The first part of an illustrated description of recent extensions to the Leeds lighting station for energy-supply purposes. The newer section of the station contained for some time only two pairs of steam engines, each pair aggregating 4000 hp and directly coupled to two-phase alternators. Recently two 3000-kw steam turbines have been installed.—Lond. *Electrician,* March 12.

Electrophysics and Magnetism.

Magnetic Properties of Carbon-Tungsten Steels.—T. Swinden.—An abstract of a paper read before the Leeds section of the (Brit.) Inst. Elec. Eng. The paper described the continuation of an investigation of the properties of a series of

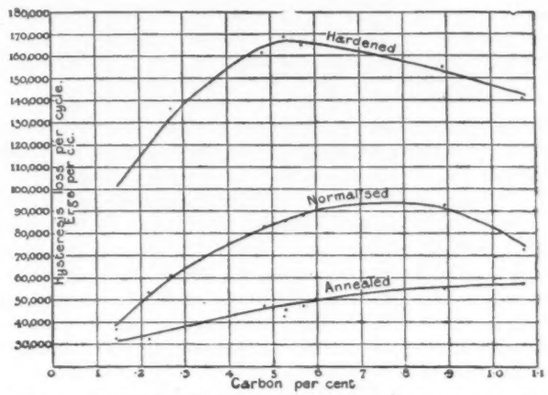


FIG. 3.—MAGNETIC PROPERTIES OF CARBON-TUNGSTEN STEELS.

constant-tungsten increasing-carbon steels. The tungsten content was maintained at 3 per cent. The relevant results of past workers are given. The tempering of hardened magnets is discussed and it is shown that apparently a definite value of intensity exists for every magnet. The correlation between magnetic and other properties is finally discussed and the importance of using the correct quenching temperature is mentioned. The change of hysteresis with the percentage of carbon is shown in Fig. 3, the tungsten content being always 3 per cent. A decisive maximum of hysteresis is found in the hardened series at about 0.52 per cent carbon. Microsections of all the steels in the cast, rolled, normalized, annealed, hardened and tempered conditions have been examined. One of the most interesting points is that concerning the tempered bars.

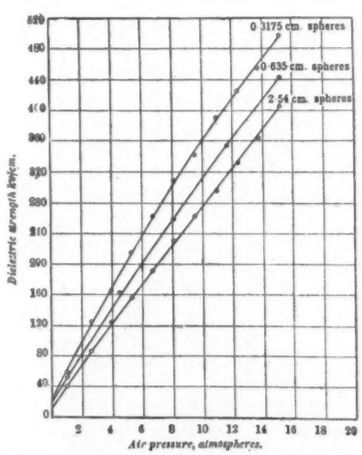


FIG. 4.—RELATION BETWEEN DIELECTRIC STRENGTH AND AIR PRESSURE.

The magnetic tests showed a tremendous increase in permeability caused by tempering, yet the crystalline structure is practically unaltered. It may be that the permanence is governed by constitution and permeability to crystallization, but many facts point to the latter being of secondary consideration in both cases.—Lond. *Electrician,* March 12.

Dielectric Strength of Compressed Air.—E. A. Watson.—An illustrated paper read before the (Brit.) Inst. Elec. Eng. Particulars are given of experiments made by the author with the object of determining as accurately as possible the manner

in which the dielectric strength of air changes when it is compressed to pressures higher than atmospheric, chiefly with a view to its employment for the insulation of certain classes of high-tension apparatus for which oil or other insulation is not suitable. Spherical electrodes were used and the results obtained with three different sizes of spheres are given in Fig. 4, which shows the relation between dielectric strength and air pressure. The dielectric strength of air at ordinary temperature—17 deg. C.—follows very nearly a linear law, but the curve when produced back does not pass through the origin; that is to say, the dielectric strength cannot be strictly said to be proportional to the pressure. If an empirical formula be desired for the lowest curve in the diagram, the equation

$$\text{dielectric strength} = 20 + 25.6 \times \text{atmospheres},$$

expresses the relation with sufficient accuracy between the pressure of 3 and 15 atmospheres absolute.—Lond. *Electrician*, March 12.

Self-Demagnetizing Factor of Bar Magnets.—S. P. Thompson and E. W. Moss.—An abstract of a paper read before the Physical Society of London. The authors discuss the significance and definition of the self-demagnetizing factor of magnets in general and of bar magnets in particular; they redetermine the values of the self-demagnetizing factor for bar magnets of circular section and determine the values for the self-demagnetizing factor for bar magnets of rectangular cross-section of various proportions. In general, for every bar magnet there is a self-demagnetizing action in the value of which at the middle of the bar depends, for a given intensity of magnetization, on the length of the bar relatively to its cross-section, on the permeability of its parts, and on the distribution of its surface magnetism. Experiments were first made on the values of the self-demagnetizing factor for bar magnets of circular section and the results were compared with those obtained by Du Bois and Riborg Mann. The values obtained were lower than those found by either of the former experimenters. Experiments were made to determine the self-demagnetizing factor for bar magnets of rectangular cross-section, and it was found that for equal values of the dimension-ratio the factor for bars having a sectional ratio of 2 to 1 was about 93 per cent of that for bars of square section, while for flat bars, having a sectional ratio of 10 to 1, the value of the self-demagnetizing factor went down to about 75 per cent of that for bars of square section.—Lond. *Electrician*, March 12.

Magnetic Hysteresis and Wave Form.—M. G. Lloyd.—An account of an experimental investigation, the chief results of which are as follows: For a definite maximum value of the flux density, the hysteresis is greater with a flat wave of flux, but the effect is small and from the industrial standpoint negligible, even with very distorted waves. If, however, the time-wave of flux is dimpled, the hysteresis may be much increased. The hysteresis determined by the ballistic method may be smaller than that which obtains with the use of alternating current, but the differences are small. The separation of hysteresis and eddy-current losses by means of runs at two frequencies, using the Steinmetz formula, is not accurate, but is a close approximation when the sheets are thin.—*Bull. Bureau of Standards*, Vol. 5, No. 3, February.

Electrochemistry and Batteries.

A Carbon-Plate Rheostat for Control of Small Electric Furnaces.—C. R. Darling.—A description of a rheostat exhibited before the (Brit.) Phys. Soc'y. The defects of the ordinary carbon-plate rheostat—the difficulty of accurate control when consuming a large amount of power—is overcome in this instrument by the use of four rows of plates, each 2 in. square in area, there being 22 plates in each row. Each set of plates is provided with a separate adjusting-screw, and hence may be kept at different degrees of tightness. By means of simple connecting devices, the plates may be used in series or parallel as desired. This form of rheostat is found to be well adapted for regulating electric tube furnaces and for varying the current to any desired extent during the calibration of instruments, etc.—Lond. *Electrician*, March 12.

Carborundum.—M. L. Baraduc-Muller.—A review of the properties, applications and methods of manufacture of carborundum.—*Revue de Metallurgie*, February.

Units, Measurements and Instruments.

Determining the Stray Currents in Water Pipes.—C. W. Kinney.—A note on a method by which the author measured the stray currents from a tramway system in a water pipe. The instruments available were an ammeter and a 600-volt voltmeter with a low-reading calibration terminal. The determination was made as follows: The water pipe was exposed for about 6 ft. of its length. Three places on the pipe, 2.5 ft. apart, were filed bright and the drop in voltage, as indicated by the voltmeter, between the first and second points and then between the second and third points was noted. After these readings had been taken, an ammeter reading was taken between the rail and the middle point on the water pipe. While the ammeter was still connected, voltmeter readings were taken as before. The voltmeter drop between points 1 and 2 showed less than one-half of 1 per cent of the original value. Thus the voltage drop between points 2 and 3 could be assumed to be due entirely to the current in the ammeter. The normal current in the pipe was then calculated by a simple proportion; that is, the current during the first test bore the same relation to the ammeter reading that the voltmeter throw between points 2 and 3 during the first test bore to the throw of the voltmeter needle when the ammeter was connected, since the voltmeter was of the uniform-scale type. It was, therefore, not necessary to determine the actual value of the divisions on the voltmeter scale in order to find the amount of current in the pipe.—*Elec. Jour.*, March.

Silver Voltammeter.—Jaeger and von Steinwehr.—An account of an investigation made at the German Reichsanstalt. The amount of silver deposited in the voltammeter does not, within the limits of experimental error, depend on whether the older form of voltammeter or the voltammeter due to Richardson is used. Absolute measurements gave, it is true, a difference of some ten-thousandths, but it was impossible to discover a measurable difference in accurate relative measurements. The removal of the oxygen during electrolysis by displacing the air by an inert gas, such as nitrogen, causes no appreciable difference in the amount deposited compared with the amount deposited when oxygen is present. This result is in accordance with the latest measurements of the (Brit.) National Physical Laboratory and contradicts the older measurements of most early observers. The values arrived at with the international ohm and legal ampere for the Weston standard cell correspond in a satisfactory manner with the results arrived at by the Reichsanstalt in 1908, while the value for this cell obtained by using the silver voltammeter corresponds very closely with the recently published results of similar work at the (Brit.) National Physical Laboratory.—Abstracted from *Zeits. f. Instrument* in Lond. *Electrician*, March 12.

Thermoelectric Pyrometer.—A description of a simple thermoelectric pyrometer for students, exhibited recently by Mr. C. R. Darling before the Physical Society at London. The hot junction of nickel and steel, or iron and constantan, is protected by a mild-steel cap, bored from the solid, and about 6 in. in length. This cap is screwed to an iron barrel of any desired length and the wires pass from the junction through twin-bore fireclay to terminals screwed into a piece of hard fiber. The terminals are made of the same metal as that of the wire attached, and leads of the same wire are taken to a cold junction, kept in oil, and the indicator. The pyrometer is easily put together by the students and is used to form a temperature-scale from the deflections of a galvanometer by insertion in molten metals or salts of known freezing points. The mild-steel cap resists the action of molten substances far better than does porcelain or silica and enables the junction to follow a changing temperature more rapidly. The errors incidental to the forms in which no provision is made for a cold junction are avoided, and no damage ensues from dropping or rough usage, as in the case of pyrometers protected by porcelain or

silica. The cap, when worn out, is readily replaceable.—Lond. *Electrician,* March 12.

Combined Meter-Bridge and Potentiometer.—A description of a combined meter-bridge and potentiometer with new tapping-key device for pyrometric and general laboratory work. It was exhibited by C. R. Darling before the Physical Society of London. The arrangement of this apparatus is that of an ordinary meter-bridge, with four gaps, but with 4 m of stretched wire, so that 1 m, 2 m, 3 m or 4 m of wire may be used in a bridge test. Between each pair of wires is placed a groove, through which pass a rod of phosphor-bronze on which the tapping key slides. These rods are connected to a terminal at the side. Hence it is not necessary to connect directly to the keys. The keys are furnished with two knife-edges and may be depressed onto the wire on either side of the groove in which they slide, thus facilitating the finding of the balance-point. Each wire is furnished with an arrangement for tightening. The apparatus may be used as an ordinary bridge or as a bridge with calibrated wire, it being possible to calibrate any wire by the aid of others. It may also be used for the measurement of the e.m.f. of thermal junctions, constants of cells, etc., and all of the ordinary purposes of a stretched-wire potentiometer.—Lond. *Electrician,* March 12.

Transformers for Measuring Instruments.—An illustrated description of a new design of an English make of transformers for measuring instruments. The chief features are a constant ratio over a range of from 10 per cent to 100 per cent and a very small phase displacement. The improved working conditions are due mainly to the use of a completely closed magnetic circuit, there being no air-gap whatever. The core plates are stamped out of the sheets in their complete and final form, and the coils are wound on the arms by means of a special device. This method of stamping out the core plates in one piece has the further advantage that it ensures uniformity of manufacture, which is not dependent upon the skill of the individual workman, as in the case of transformers in which the core plates are butted or otherwise joined.—Lond. *Electrician,* March 12.

Magnetic Testing.—M. G. Lloyd.—A paper on errors in magnetic testing with ring specimens. The author discusses the magnetizing force and the losses for both rectangular and circular sections.—*Bull. Bureau of Standards,* Vol. 5, No. 3, February.

Resistor of Standard Resistance.—E. B. Rosa.—A description of a new form of standard resistor. The object of designing it was to exclude the effect of humidity in the air upon the value of the resistance. For this purpose the coils are enclosed in vessels filled with oil and hermetically sealed.—*Bull. Bureau of Standards,* Vol. 5, No. 3, February.

Meter and Relay Connections.—H. W. Brown.—In a continuation of his illustrated serial the author deals with meter and relay connections for six-phase circuits and discusses especially the double-delta connection and the diametrical connection.—*Elec. Jour.,* March.

Telegraphy, Telephony and Signals.

Multiplex Telegraphy.—M. H. Magunna.—An illustrated paper read before the International Telegraph Congress at Lisbon. The author described the latest method of Mercadier for multiplex telegraphy. Alternating currents of different frequencies are produced by means of operation of tuning forks. At the receiving station they act on "monotelephones" which are tuned to the pitch of the tuning forks in the transmitting station. These "monotelegraphs" actuate relays which operate ordinary Morse or Hughes apparatus.—*Elek. Zeit.,* March 11.

Wireless Telegraphy.—F. Kiebitz.—A critical discussion of the principles of construction of wireless telegraph stations. The modern methods for producing high-frequency currents have such a high efficiency that any further increase of efficiency would not produce any considerable advance in wireless telegraphy. On the other hand, improvement may be made by selecting the dimensions of the transmitting system according to Drude's formulas. By using several antennas it is possible to send wireless telegraph messages in a certain desired direction without reducing the distance of transmission. For a receiving station it is advantageous to couple a non-periodic detector circuit with the antenna circuit by magnetic induction. —*Elek. Zeit.,* March 11.

Miscellaneous.

Electric Ignition.—J. Loewy.—The first part of an illustrated paper on the electric ignition of gas engines for automobiles and for stationary purposes.—*Elek. Zeit.,* Feb. 25.

NEW APPARATUS AND APPLIANCES

Impulse Type of Steam Turbine.

The steam turbine built by the Kerr Turbine Company, Wellsville, N. Y., utilizes the principle of the Pelton waterwheel, so successfully employed under high heads of water. The buckets on the turbine, like the buckets of the waterwheel, are of the double-cup variety, excepting that in the turbine they are made of a form suitable for the use of steam.

The turbine is of the multi-stage, bucket and nozzle, impulse type, each stage consisting of a set of nozzles and a bucket wheel with double-cap buckets set in its periphery, and the whole enclosed in a sectional casing of cast iron.

There are two points only at which the shaft is in actual rubbing contact with the stationary parts of the turbine, and these are the bearings. The bronze bushings which prevent leakage of steam from stage to stage at the points where the shaft passes through the diaphragms and through the steam and exhaust ends are reamed a few thousandths of an inch larger in diameter than the shaft and have radial clearances outside so as to take any position corresponding to that of the shaft, while the steam pressure holds them to a ground metal to metal seat in the diaphragm casting. In addition to these bushings at the steam and exhaust ends of the turbine, there are packing glands for soft ring packing. Between the soft packing glands and the metal glands is a chamber which receives the leakage from the metal gland and discharges it through a pipe connection to one of the low-pressure stages of the turbine.

At the exhaust end of the turbine, if it is to run condensing, is a corresponding chamber which is supplied with water. This furnishes an effective means of sealing the shaft against leakage of air into the vacuum. In the case of a non-condensing turbine the soft packing is all that is required.

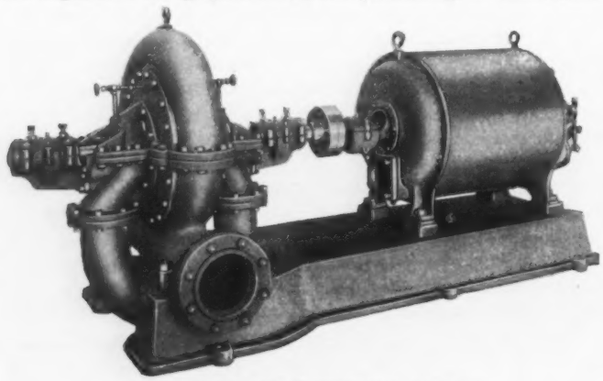
The shell or cylinder of the turbine is made up of two end castings, between which are diaphragm castings, which contain the nozzles, and divide the cylinder of the turbine into separate stages. The diaphragms are accurately centered with each other and with the two end castings by turned and bored tongue-and-groove joints. Outside the grooves the diaphragms are in contact on an accurately faced metal-to-metal joint. The groove is packed with fibrous packing. The end castings carry the weight of the turbine and are provided with accurately faced supports which are bolted to the bed plate.

The buckets are drop forged from steel, and the spindle or rotor is made up of a steel shaft, upon which are mounted the bucket wheels, the number of which depends upon their own diameter, range of steam pressure which the turbine is to operate and the r.p.m. of the driven machine. The bucket wheels are machined and slotted to receive the buckets, the shanks of which are inserted and riveted into dove-tailed slots. The rotor runs with remarkable freedom from vibration. The

bucket wheels are mounted on cast-iron rings, threaded on split hubs and keyed to the shaft. The wheel is thus easily and quickly removable. Because of the comparatively light weight of the rotating element, a shaft of small diameter is used, both in the bearings and in the glands where the shaft passes through the turbine casing. This permits a design of bearing which is at all times safe from overheating, as the actual surface speed of the shaft in the bearing is not great, notwithstanding the high rotative speed of the shaft.

The governor employed is of the centrifugal type, and is mounted on the end of the shaft, rotating with it. The movement of the governor weights, which are of semi-annular section, is effected by knife-edge and rolling contacts. Freedom of movement is thus secured without lubrication. The speed regulation is made to suit the requirements of the driven machine. Ring oiling bearings, arranged with a special device and grooves for delivering a large quantity of oil, are employed. The oil reservoirs into which the rings dip are of more than usual proportions. A suitable thrust-bearing is provided in connection with the exhaust end-bearing, by means of which the bucket wheels are kept in correct position with reference to the nozzles. The form of coupling used for connecting the turbine with other machinery is said to run absolutely noiseless and not to absorb power.

The application of the turbine to the driving of both direct and alternating current generators has been quite successful. The simplicity of the turbine makes it easy to operate, and the regulation being quite close, the paralleling of alternators



TURBINE-DRIVEN CENTRIFUGAL PUMP.

is readily accomplished. The steam consumption of the turbine is said to compare favorably on non-condensing work with that of high-speed engines of the same rating working under similar conditions, while on condensing work the economy is said to equal that of the best high-speed compound engines of the same rating at full load, and to show somewhat better results on partial loads.

The turbine has also been widely applied for driving centrifugal pumps, for boiler feed and other purposes, where the speed of the pump is high enough for direct connection to the turbine. The combined unit forms an ideal means of moving water and other liquid against moderate or high heads. The motion being purely rotary there is an absence of jar. The turbine has been used for driving centrifugal boiler feed pumps of single-stage or multiple-stage type, and the simplicity of the set in contrast with the ordinary reciprocating sets is very marked. As there is no oil in the exhaust from the turbine, this can be passed directly into either a closed or open-feed water heater. Such pumps, working of a necessity against comparatively high pressures, must run at high rotative speeds, which are favorable for the economical working of a turbine of this type. It is estimated that under these conditions, aside from the reliability, the turbine will require less steam to do a given amount of work.

For driving centrifugal pumps delivering a large volume of water against a low head, as in circulating water for condensers, the economy of the turbine is not so good, for the reason that these pumps run at a comparatively low speed.

Exhibits at the Worcester Electrical Show.

An electrical and mechanical exhibition was opened in Mechanics' Hall, Worcester, on March 27, under the auspices of the Worcester County Mechanics' Association. A large variety of products of interest to the electrical and machine trade was displayed. The Worcester Polytechnic Institute, Department of Electrical Engineering, exhibited several thousand dollars' worth of standards tested at the Reichsanstalt, English Board of Trade laboratory, and American Bureau of Standards. It showed a mercury arc rectifier set, apparatus illustrating the principle of the rotating magnetic field, Kelvin, Wolff, Weston and Westinghouse instruments. The Washburn shops of the Institute exhibited motor-driven, variable-speed drills, lathes and grinders of recent design.

The Shepman Envelope Company, of Worcester, showed a motor-driven gumming, folding, drying and counting envelope machine having a capacity of 80,000 envelopes daily. The Power Maintenance Company, of Worcester, exhibited a full line of telephone and bell fittings, small motor, lighting and automobile supplies. The Coghlin Electric Company, of Worcester, showed a "Wigwam" portable house fully equipped with electric lighting in plain and ornamental styles, heating appliances for the kitchen and bedroom, sewing machine motors and bathroom heating equipment, electric vibrators and vacuum cleaner. The Leader Manufacturing Company, of Hartford, showed a motor-driven suction cleaner of the portable type, for domestic service. The machine is operated from an ordinary lamp socket.

The W. D. Kendall Company, of Worcester, exhibited a full line of Shelby tungsten incandescent lamps, Simplex heaters, a Holtzer-Cabot motor-driven house pumping set operated by friction drive, and a line of Holtzer-Cabot buffing, polishing, grinder and lathe motors. The pumping set is a relatively new design, consisting of a rotary bronze pump having a capacity of 500 gal. of water per hour. It is run by a ½-hp, direct-current or a 1-hp, alternating-current motor, and occupies a floor space of 17¼ in. x 18¾ in. x 18 in. An Excello arc lamp was shown and a Holtzer-Cabot automobile ignition magneto was also exhibited. O. S. Kendall & Son, Worcester, showed Simplex vacuum cleaners, motor driven and hand operated.

Alsten & Goulding, Worcester, had an exhibit of Wheeler & Schebler magnetos, the Hoyt automobile measuring instruments, Packard cables, the Globe sheet-steel battery box, "Worcester" combination rotary switch, Klaxon horns, spark coils, timers, plugs and accessories.

The Acme Wireless Construction Company, of Cambridge, Mass., displayed apparatus for wireless telegraphy, with working exhibits. The Coates Clipper Company, of Worcester, showed flexible shafts for portable motor-driven outfits. The Dow Surgical Battery Company, of Boston, showed the Arnold vibrator. The Blake Pump & Condenser Company, of Fitchburg, Mass., showed pumping equipment of recent design.

Power for the exhibition was furnished by the Worcester Electric Light Company, which had an attractive display of electric heating and cooking appliances of General Electric make, tungsten lamps with the prices of burning tabulated for the convenience of the public, luminous radiators, fan motors and small apparatus for domestic service on central-station circuits, portable drill and flatirons. All the machinery in the exhibition was motor-driven.

Electricity in the Hotel La Salle, Chicago.

The large and handsome Hotel La Salle, which is rapidly approaching completion in Chicago, will have many features of electrical interest. Electricity will be generated in a 1100-kw private plant in the sub-basement. This will include three Crocker-Wheeler generators, rated respectively at 500, 350 and 250 kw. These machines are wound for 250 volts direct current, and are direct-connected to Fitchburg four-valve cross-compound engines. The generators are guaranteed to withstand

50 per cent overload for two hours and 25 per cent overload continuously. The Western Electric Company is building a switchboard 30 ft. long, consisting of 14 panels and equipped with I-T-E circuit-breakers, etc. Steam is produced in five boilers having an aggregate rating of about 2000 hp. Automatic stokers are provided, and each one is driven by a direct-connected Crocker-Wheeler motor.

Extending 21 stories above the street level and two stories below it, the hotel contains 1035 guest rooms, and about 20,000 16-cp incandescent lamps will be installed to light the building. The fixtures are especially designed, and some of them, notably in the ballroom and in the main dining-room, will be very large and handsome. All wiring of every description, including telephone and bell wiring, is run in iron conduit. The corridors will be lighted by 60-watt tungsten lamps, but ordinary carbon-filament lamps will be used in the guest rooms. Each bedroom is provided with an electric reading-lamp placed on a stand at the side of the bed.

Electric cooking will be a feature of the German restaurant grill, and this innovation will undoubtedly attract much attention. Every bathroom in the house will have electric curling-iron heaters, and all doors to clothes-closets will be equipped with revolving door switches, automatically cutting in and out the light inside the closet with the opening and the closing of the door. Electric motors having an aggregate rating of about 400 hp will be needed in the hotel. In addition to the heavier machinery they will drive revolving entrance doors, vacuum-cleaning pumps, dumb-waiters, potato-peelers, dish-washers, silver-buffers and ice-cutters used for making cubes of ice for iced drinks.

In the laundry electricity will not only be used to operate the machinery, but electric heat will be relied upon for ironing and other purposes. The valets' room will be equipped with electric flatirons and an electric drier to be used particularly for the purpose of expediting the work of pressing trousers. The carriage call will be electrical and noiseless. Where there is a long line of waiting carriages for guests the doorman at the carriage entrance will press the number of each individual carriage call on a keyboard resembling that of a typewriter, when the number desired will appear in figures of electric light on each side of the canopy over the entrance. Each guest room will be provided with a telephone of a special flush type, only the transmitter and receiver projecting from the wall. A 1200-line telephone switchboard will be installed, and a force of about 20 telephone operators, divided into eight-hour shifts, will be needed. Forty trunk lines will connect this switchboard to the main exchange of the Chicago Telephone Company.

Holabird & Roche, Chicago, are the architects for this fine hotel, and the Arthur Frantzen Company is the electrical contractor.

Reinforcing Decayed Poles.

The accompanying illustrations show a process for reinforcing decayed wooden poles by means of concrete without disturbing the electric circuits which the pole supports.

The pole to be reinforced is supported by tripods or held securely in place by temporary guy ropes or wires; the earth is then removed for a distance of about 18 in. from the sides of the pole to a depth that will expose the solid portion of the butt remaining. The decayed portion of the pole is then scraped out. Half-inch steel rods from 3.5 ft. to 6 ft., and pointed at both ends, the upper end being bent at right angles to form a dog or point from 5 in. to 6 in. long, are used for reinforcing. The straight end of the rod is driven into the sound portion of the butt at an angle by the use of a special driving tool. The upper portion of the rod is then bent in toward the pole and the dog is driven in to its full length. The length of the rod used is such as to permit the proper anchorage of its lower end in the sound wood of the butt, and to allow the portion extending above the ground to be of sufficient length to span the decayed section of the pole and be driven into perfectly sound wood. The points of the rods are usually driven into the pole from 12 in. to 18 in. above the ground level. Concrete is filled in around the pole, replacing the decayed portions of the wood and forming a protecting sleeve or envelope. This concrete extends above the ground sufficiently far to cover the upper

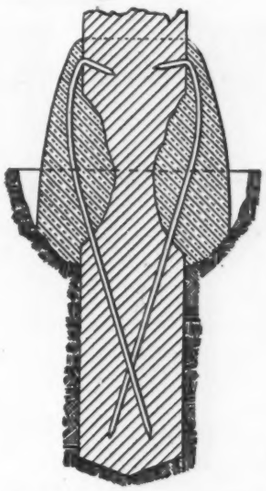


FIG. 1.—DIAGRAM OF METHOD OF REINFORCING DECAYED POLES.

terminals of the rods and protect them from the action of the moisture in the air, thus forming a sort of collar above ground, and tapering from about 3 in. thick at the ground level to about 1.5 in. at the top. It is finished off in a sightly fashion by a form designed for the purpose. Where the butt of the pole is partly rotted away, the rotten portions are removed and the

FIG. 2.—POLE READY TO RECEIVE CONCRETE REINFORCEMENT.

space is filled in with concrete, thus providing an anchorage for the rods either in the solid wood of the butt or in the concrete.

If the butt is entirely rotted away a concrete base is made of

slightly larger dimensions than the pole in which the rods are firmly anchored. The pole is cut off squarely and rests upon this concrete base. The upper portion of the rods projecting from the base and surrounding the pole is then bent in and the

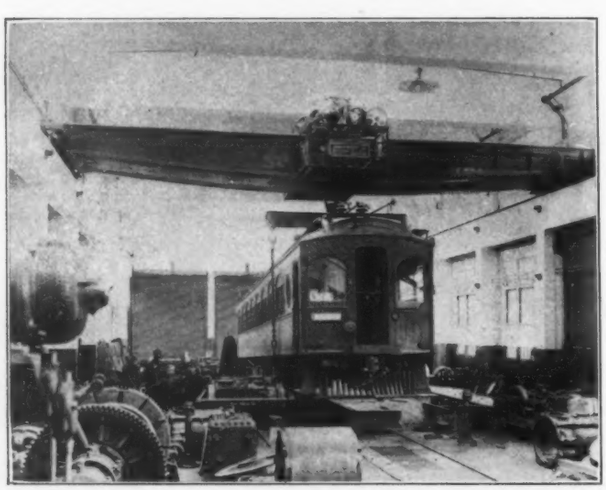
FIGS. 3 AND 4.—POLES REPAIRED WITH REINFORCED CONCRETE BASES.

dogs are driven home as in the first case. A concrete shell, such as before described, is placed around the pole to protect the rods, thus giving poles reinforced by either method a similar appearance above ground. The steel rods and concrete form a practically homogeneous mass said to be superior in strength to the wood alone when new, and equally capable of sustaining the side strain which every pole must stand. It is stated that the cost should not exceed $3.50 per pole, while the life is increased by 10 years.

The process described above has been patented by Mr. R. S. Orr. His patents have been purchased by the Pittsburgh Reinforced Pole Company, Pittsburgh, Pa.

Electric Crane for Car Repair Shop.

The accompanying illustration shows the interior of the car repair shop of the Washington, Baltimore & Annapolis Electric Railway at Academy Junction, Md. The electric traveling crane



ELECTRIC CRANE IN CAR SHOP.

was provided to be used just in setting the new shop machinery and later to handle car bodies and heavy running gear parts. The traveling crane is used to place a wall crane on any pilaster where needed, so that a small number of wall cranes will render very good service over the entire shop. The traveling crane has a span of 42 ft. and is provided with a 15-ton main hoist and a 6-ton auxiliary hoist. The main hoist is operated by a 20-hp motor, the auxiliary by a 15-hp motor, the bridge travel by a 15-hp motor and the trolley travel by a 3.5-hp motor. The motors are Westinghouse 550-volt, direct-current machines; the controllers were built by the Electric Controller & Manufacturing Company, Cleveland, Ohio. The traveling crane was designed, built and erected by the Whiting Foundry Equipment Company, Chicago. The designing engineers for the repair shop were the Roberts & Abbott Company, Cleveland, Ohio.

Low-Pressure Turbo-Generator Plant.

There was recently placed in successful operation at the Vandergrift plant of the American Sheet & Tin Plate Company an outfit consisting of a Rateau steam regenerator, a Rateau-Smoot low-pressure turbine and a Smoot direct-current generator. It utilizes the exhaust steam from reversible blooming-mill engines which work intermittently and at widely varying loads, thus having a supply which is constantly differing in volume. The generator was installed in order to overcome this variation and to supply the turbine with a steady flow of steam.

The regenerator is a cylinder, 40 ft. long, 8 ft. in diameter, containing about 45 tons of water. This water is heated by the exhaust steam from the mill engines; the storage of heat energy within the water is such that the engines may be completely shut down for two minutes and yet the regenerator will supply steam to the turbine at the rate of 25,000 lb. per hour. If the mill engines are idle for more than two minutes live steam is admitted to the regenerator for the continuous operation of the turbine.

The turbine is a 600-kw unit receiving steam at atmospheric pressure from the regenerator and exhausting into a condenser at not over 3 lb. absolute; thus its pressure range is from 15 lb. to 3 lb. per square inch. It is of the impulse type originated by Professor Rateau and redesigned by Mr. C. H. Smoot. The steam admission is controlled by a fly-ball governor which maintains the speed within 1 per cent from no-load to full-load. Details of the Rateau turbine have already been described in our columns.

The generator is a 250-volt direct-current machine operating

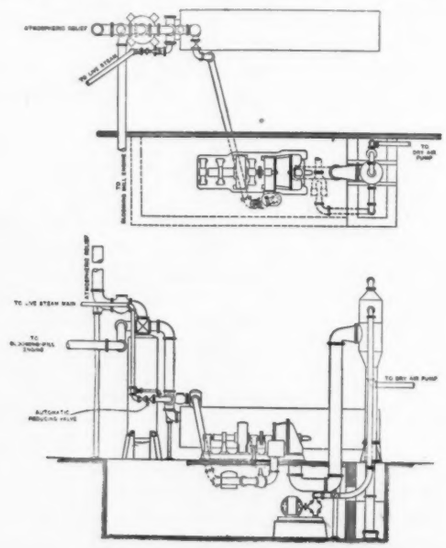


FIG. 1.—LOW-PRESSURE TURBO-GENERATOR PLANT.

at 1500 r.p.m. It is provided with four main poles and four commutating poles. The commutator is in two sections, held together against centrifugal force by nickel-steel retaining rings shrunk in place. The commutation is said to be first-

class, and the fact that the commutator does not have to be lubricated removes a serious objection to the use of direct-current generators in plants such as the Vandergrift one, where the metallic dust in the air might settle on the oily surface

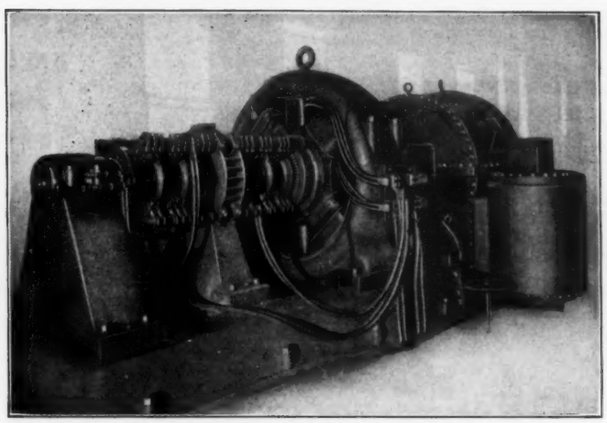


FIG. 2.—LOW-PRESSURE TURBO-GENERATOR.

and cause short-circuits which would seriously injure the machine. The generator is of the open-frame type with no forced-air circulation. It was designed by Mr. Smoot.

The above-described equipment was built by the Ball & Wood Company, Elizabethport, N. J.

Fixture for Tungsten Lamps.

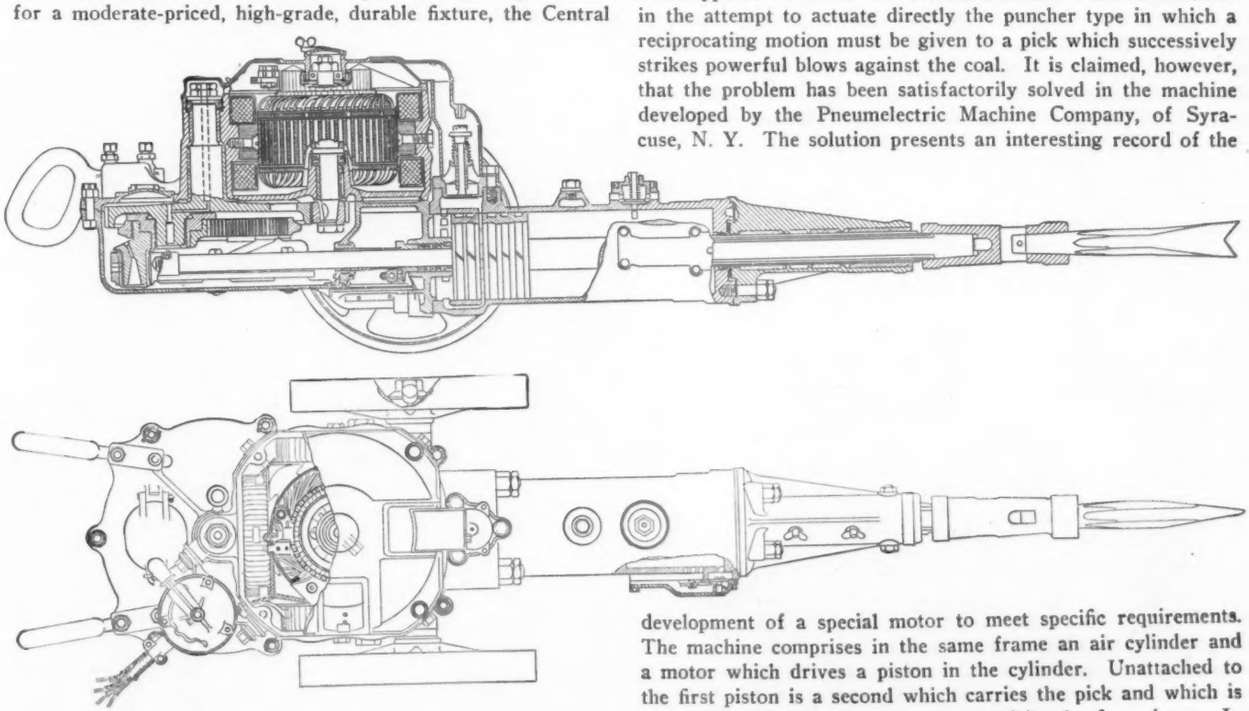
As a means to combating gas competition and improving the service of customers, the tungsten lamp has firmly established itself, and with the advent of the so-called tungsten arc fixtures the electric light managers secured a very effective weapon for fighting gas competition or giving dissatisfied customers more effective illumination for the same input. Recognizing the field for a moderate-priced, high-grade, durable fixture, the Central Electric Company, Chicago, Ill., developed the cluster illustrated herewith and which is known as the "Tungstolite." This does not differ materially from the accepted standards, and embodies a number of structural features. The reflector, 18 in. in diameter, consists of an opal glass shade, formed to the proper angle to give the best diffusion of light and the highest reflecting qualities. The brushed brass canopy is 4 in. x 5 in., the stem consisting of ½-in. iron pipe covered by 1-in. brushed

FIXTURE FOR TUNGSTEN LAMPS.

brass casing, thus giving a pleasing and uniform effect. Each fixture is supplied with an iron crowfoot fastened to a white porcelain steel reflecting plate, on which the sockets are mounted. It measures 25 in. over all when assembled with lamps, and can be used with 25-watt, 40-watt or 60-watt tungsten lamps as desired. Each fixture is packed in a substantial, individual wooden box ready for immediate shipment; these individual boxes are then mounted in shipping crates, so that when received the crates only are opened and each fixture can be forwarded to its destination without unpacking and without danger of breakage. Several combinations are furnished enabling the use of 3-, 4- or 5-lamp clusters.

Motor-Driven Pneumatic Coal Puncher.

The application of electricity to coal mining presented no great difficulties so long as a motor was required to drive the chain type of machine. But serious obstacles were encountered in the attempt to actuate directly the puncher type in which a reciprocating motion must be given to a pick which successively strikes powerful blows against the coal. It is claimed, however, that the problem has been satisfactorily solved in the machine developed by the Pneumelectric Machine Company, of Syracuse, N. Y. The solution presents an interesting record of the development of a special motor to meet specific requirements. The machine comprises in the same frame an air cylinder and a motor which drives a piston in the cylinder. Unattached to the first piston is a second which carries the pick and which is actuated entirely by the air compressed by the first piston. In its early stages it was prophesied that the motor would not withstand the heavy jar and the effect of concussion. This effect was, however, practically overcome by the ingenious cushioning of the pick-carrying piston. The transformation of circular into rectilinear motion presented an interesting prob-



FIGS. 1 AND 2.—ELEVATION AND PLAN OF COAL PUNCHER.

lem which was solved by the use of gears, as shown in the accompanying illustration.

The claim is made by the manufacturers that the motor is the lightest built for its output. Much of the trouble in the early days of its design arose from the fact that the motor must be enclosed and consequently that ventilation and heat radiation must receive the most careful consideration. Exhaustive tests were made under conditions considered equivalent to those in the mine. Successful ventilation and cooling were finally attained in the following manner: The air to be compressed is drawn in through the armature and field windings

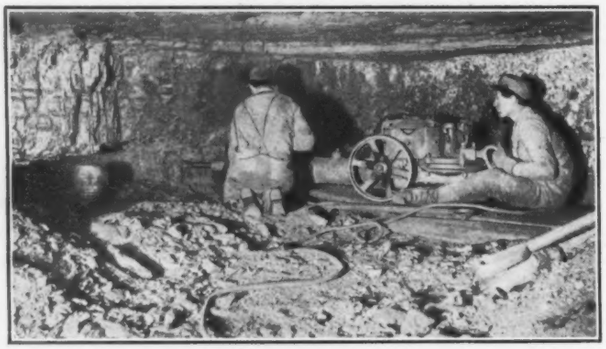


FIG. 3.—COAL PUNCHER IN OPERATION.

at each forward stroke of the air-compressing piston. By this means about 28 cu. ft. of cool air per minute passes over the heated parts at a velocity of about 2.5 ft. per second when striking about 165 blows per minute. This equipment has been found very effective, and is at the same time entirely automatic, no auxiliary appliances being required. The motor, which is of the ordinary series-wound, four-pole type, possesses no unusual features tending to make it complicated or requiring special generators for supplying energy. This motor, whose shaft is vertical, is completely enclosed, the motor frame and gear-case cover being made in one piece of cast steel; by this means strength, minimum weight and simplicity are secured. Support for the upper or commutator end of the motor shaft is furnished by a Hess-Bright radial ball bearing. At the lower end there are provided a ball thrust-bearing for taking the weight of the armature and a long bronze bushed bearing for taking up the lateral thrust due to the motor drive.

The armature is wound in such a way that each slot contains one-half of two independent coils which are machine wound and insulated before they are placed in the slots. The insulation on the coils is of the water-resisting quality. The field coils are also waterproof and are held in position with clamps so that they cannot vibrate or be injured.

New Factory for Manufacture of Electrical Instruments and Circuit-Breakers.

The Roller-Smith Company has moved into its new factory, near Bethlehem, Pa., and now possesses one of the most complete plants in the country for the manufacture of electrical instruments and circuit-breakers. The company was organized last July, as detailed in the *Electrical World* at the time, and was in effect a combination of The Whitney Electrical Instrument Company, of Penacook, N. H., and The Switchboard Equipment Company, of Bethlehem. The purpose of the new organization is the manufacture of the lines of instruments and circuit-breakers which in the past have been made by the above respective companies, and also the manufacture of electrical apparatus of allied lines.

The new factory is a two-story brick building of the gallery type, with monitor roof, and a one-story building containing chiefly the heating plant, foundry, pattern room and enameling ovens. It is located on a 2½-acre plot, on the main road between Bethlehem and Allentown. The main factory building is arranged for general machine shop, tool-room, woodworking room, grinding room, plating room and stock room on the first floor, with offices, draughting department, experimental department, circuit-breaker assembling department, instrument-assembling department, and lavatories on a gallery, 25 ft. wide, extending around the entire shop and surrounding a light well under the monitor. The main floor is concrete, reinforced where necessary for heavy presses. All of the departments above referred to are separated by 4-in. hollow tile partitions, thus reducing the danger of fire and inconvenience of dust to a minimum; all doors are iron-clad, and all interior windows made of heavy wired glass. On this floor power is divided into three units, driving respectively the main machinery, the grinding and wood-working machinery, and furnishing current for plating and charging the two 8000-amp storage batteries which are used for testing both instruments and circuit-breakers. All power is furnished by the Lehigh Valley Transit Company from its large stations at Allentown, both alternating and direct current being supplied. On the gallery floor are separate power units for the finer machine work on circuit-breakers and for the precision lathe work employed in the manufacture of instruments.

In the northwest corner of the main floor is a large woodworking department for the manufacture of instrument cases and cabinet work for all the different types. Adjoining is the finishing room, where the cases are finished and made ready for the last step; the varnishing is done in an adjoining room, separated by fireproof partitions.

To the east of the carpenter shop is the grinding room, in which all of the grinding and polishing of the metal parts are done. This room is, like the others, made both fireproof and dustproof, and is properly equipped for the removal of all the dust thrown down by the grinding and polishing machines operating here. Adjoining is a similar room, in which is done the plating of the metal parts.

In the southeast corner of the first floor is the stock room and shipping department, so located and arranged as to be at once convenient to all parts of the shop, and also for the speedy handling of outgoing and incoming material. With the exception of the southwest corner of the lower floor, which is given over to a complete tool room operating in connection with the machine shop, the balance of this floor is used for the general machine shop where the heavier parts of the circuit-breakers and instruments and tools are made and machined. On

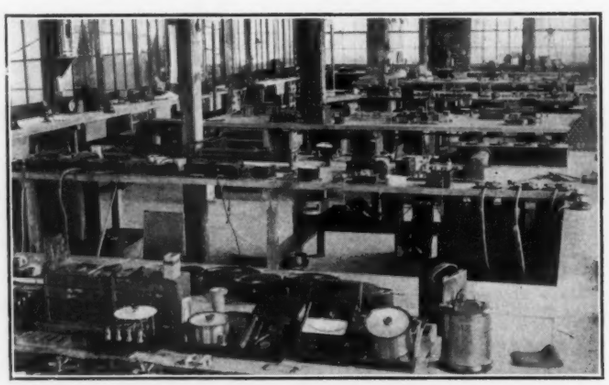


FIG. 1.—NORTH END OF INSTRUMENT ASSEMBLY ROOM.

this floor also are the storage batteries and the boards for the testing and calibrating of circuit-breakers, which, through these batteries and auxiliary apparatus, may be directly calibrated up to and including 10,000 amp.

Just at the head of the entrance stairs on the gallery floor are the offices of the factory, consisting of one general room and two private offices. The superintendent's office is so arranged that practically every point in the shop can be seen by him without his leaving his desk. Next to the offices is the draughting department, and adjoining it and a part of it, the experimental department, where all experimental work and de-

signing is completed before the drawing is given to the shop for manufacture.

Along the west and a part of the north sides of the gallery is carried on the manufacture of some of the smaller parts of instruments and circuit-breakers, and also the assembling of circuit-breakers. On the north side is the precision tool work, where are located the several precision and jeweler's lathes requisite to the manufacture of the finest parts of the instruments.

The entire east gallery, which is separated from the rest of the shop by dust-proof glass partitions, is given to the assembling of instruments. This large room, which is directly lighted through three outside walls and from the monitors through the fourth, was designed particularly for this purpose, and is entirely free from vibration, as there is no machinery beneath it and none but the small precision lathes within 50 ft. of it. In this room, in addition to commodious benches all around the four sides, are large transverse benches on which assembling the work is done. In addition to the builders' paper, which lies between the 3-in. spruce and 1-in. maple floor throughout the second floor, heavy tar paper was laid with hot wiped joints, thus minimizing the chance for dust to the lowest degree. The current required for the calibration of instruments in this room is drawn from the storage batteries directly beneath.

Just north of the main building is a one-story building, in which are the heating boilers, the blacksmith shop, the foundry, the pattern room, and the enameling room. Both buildings are heated by the vacuum steam system, steam being supplied by twin boilers manufactured and installed by The Messinger Manufacturing Company, Tatamy, Pa., the boilers being so arranged that in severe weather they may be coupled up and in more moderate weather the fires of one withdrawn. In the same room with the boilers, and on the same level, are four furnaces for the melting of the brass, aluminum and copper for castings of these respective metals; all the castings used in the circuit-breakers and meters, with the exception of iron castings, are made by the company under its own supervision. In this room, also, is the blacksmith shop, where the magnets used in the instruments are made. Adjoining the foundry room, and connected therewith, is the pattern room, in which are kept all of the wood and metal patterns required for both instruments and circuit-breakers. Next to the pattern room, and

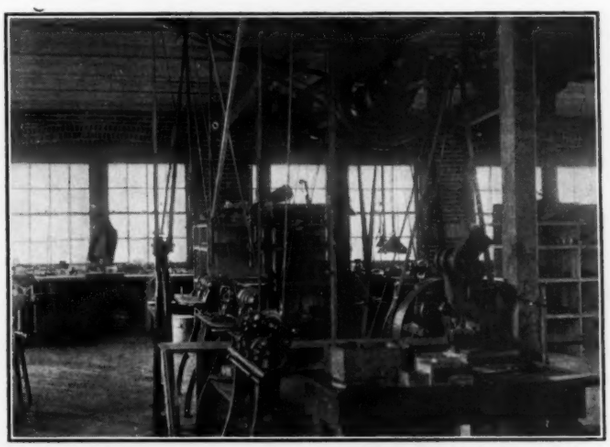


FIG. 2.—NORTH END OF CIRCUIT-BREAKER ASSEMBLING ROOM.

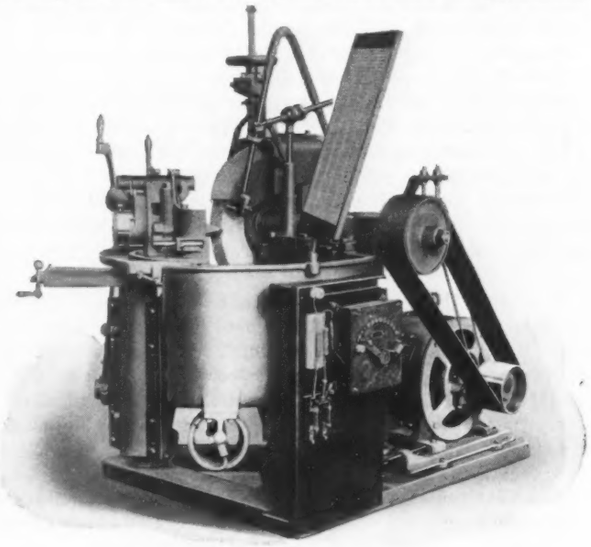
separated therefrom by a solid fireproof wall, is the enameling room, which, because of the class of work, is as fireproof as modern methods can make it.

Both the main factory and foundry buildings are constructed on the unit plan, the east walls being so built that without in any way weakening the floor and roof they can be knocked down, it being the intention of the company to build on the east side of the present factory a duplicate of the present shops.

The company reports that since it began the regular manufacture of its products, about Jan. 15, it has increased the force by over 50 per cent, and even yet is slightly handicapped and compelled to look to neighboring labor markets for the high-skilled operatives it needs.

Grinding Tools by Machinery.

Perhaps nothing is a better indication of the progress which is being made in the organization of machine shops than the development of tool grinders, from the old form of soft grindstone running at a slow speed up through the higher-speed emery wheel to the present automatic tool-grinding machine. The advantages of doing work by a definite system instead of in a haphazard manner is well understood and the production



ELECTRICALLY DRIVEN TOOL GRINDER.

of interchangeable parts is the result. But the standardization has gone further than to the finished product and now includes the tools used in the machines.

With the perfection of a machine to grind the various tools that are used on planers, lathes, boring mills, shapers, slotters, etc., in fact, practically all the machines used in machine shops, and one which will do it automatically and accurately, a great stride has been made toward uniformity of tools and hence maximum production from the machines.

Such a machine has been designed and placed in the market by Wm. Sellers & Company, Inc., which is claimed to do the work better than is possible by any other method. It is first necessary to adopt standard forms and cutting angles for the various tools and then every tool ground thereafter will conform to the standard which has been found to be the best suited to that work.

Illustrated herewith is an electrically driven universal tool grinder which will grind all manner of cutting tools except those with concave curves and re-entrant angles less than a right angle. It is shown driven by a 7½-hp, direct-current, constant-speed motor of Westinghouse manufacture, running at 975 r.p.m. The motor is mounted on the subbase of the grinder, and a starting rheostat with fuses and switch is also mounted by the side of the grinder, resulting in a most compact and convenient equipment.

With the grinder the company supplies a set of tools which it has found from experiment to be best designed for various classes of work, but provision is also made so that any form of tool, within the limitations of the machine previously mentioned, can be ground correctly to the standard adopted. It is to be especially noted that this machine is operated successfully by unskilled labor because of the automatic feature by which shapes are accurately duplicated both rapidly and reliably.

A rotary pump forces water to the tool being ground through

a system of jointed pipes ending in an adjustable nozzle, furnishing a large volume of water at a low velocity. This arrangement is so made as to prevent the water from splashing and keeps it away from the working parts. With the machine is supplied a table which shows the adjustments for various tools, etc., so that it is very simple for an unskilled operator to learn to do all the grinding of the cutting tools.

Combination Junction-Box and Pothead.

When lead-covered cables are terminated in power houses and substations, the insulation at their ends is always carefully sealed in by means of potheads to prevent moisture from entering between the lead sheaths and the cable. It is manifestly inconsistent to open cables in a similar manner in underground manholes where moisture conditions are much worse, without likewise sealing the insulation against moisture. The G. & W. Electric Specialty Company, 128 West Jackson Boulevard, Chicago, which has made a specialty of designing and manufacturing porcelain potheads and cable terminals for power-station and arc-circuit work, is just placing on the market a combination junction-box and pothead for use in manholes or in other places where lead-covered cables terminate in junction or fuse boxes.

The external appearance of this box is shown in Fig. 1 and the details in Fig. 2. The lid laps over the sides of the box so as to form an inverted bell which catches the air under the lid as water rises around the box and prevents water from entering the box. As a protection against moist air and dust, a heavy rubber gasket is placed in the lid, and lugs and bolts make it possible to draw the lid down tightly on the box. The lid of the porcelain box has locking handles, by means of which the enclosed cartridge fuse can either be removed with the lid of the box when the cover is taken off or left in circuit in the bottom of the box.

The fuse clips are entirely above the level of the entering cables. Consequently the cables can be sealed in by pouring suitable insulating compound in the box nearly up to the fuse clips. This completely covers and seals the insulation at the end of the lead-covered cable. At the same time the manipulation and installation of the terminals are comparatively easy. The method of installing and connecting the box will be plain from a study of Fig. 2, which shows the box taken apart. In this cut, the part numbered 2 is one of the fuse clips. In the bottom of this clip is the cable terminal lug into which the cable conductor is sweated; the clips are removable during this sweating process in order that their temper may not be affected by the heat. After the cable has been sweated into the terminal (2) the porcelain block (3) is slipped into the terminal and fastened with the screws (4), producing the combination seen in (1). This porcelain block (3) when slipped into the terminal lug also slips into the recesses made for it in the lower part of the ends of the box (5), the fuse terminal clip thus being held in place. This process being repeated for the other terminal, the porcelain box is sunk in the iron box and hot compound is poured in up to the level of the fuse clip. The lead-covered sheath is wiped to the wiping thimbles which are fastened to the iron box, as seen in Fig. 1.

FIG. 1.—VIEW OF BOX.

These boxes are made for single-, two-, three- and four-conductor cable. They are designed for voltages up to 6600.

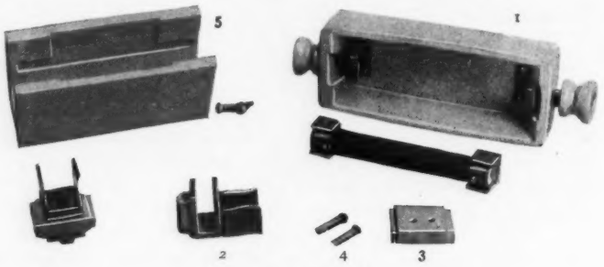


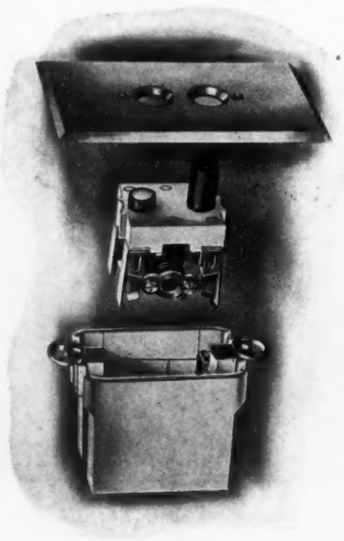
FIG. 2.—DETAILS.

These various types are made both for ½-tap for branches and for straight-tap, as shown. The box is about 14 in. long. With the types available it is therefore possible to either insert a main fuse or to make the box serve as a branch connector. The difficulties of locating the trouble on branch circuits where cables or lines must be cut are well known.

Detachable Flush Switch.

To install the old style of flush push-button switch in a wet plastered wall of a new building is to subject it to a hardship which it is little fitted to overcome. The steel parts, the springs, the metal rivets and pins promptly corrode—especially in cases where they are not used at once—and the springs break when it is attempted to operate them, or a break-down is only a matter of time. When this occurs a complete new switch is necessitated, the wires have to be disconnected and in so doing are often broken and have to be spliced.

While it may be true that some of the old-style switches installed 10 to 15 years ago are still in use, this may be accounted for by these having been made of all cast parts, very heavy and capable of carrying 25 amp or more. In some cases it took the strength of a man with a muscular thumb to work them. Since the ruling of the Underwriters of about 10 or 12 years ago limited circuits to 12 lights, the switches have been made of lighter construction to get an easier push. In an installation in New York of about 5000 switches, three complete



DETACHABLE FLUSH SWITCH.

equipments of different-make switches were used in eight years.

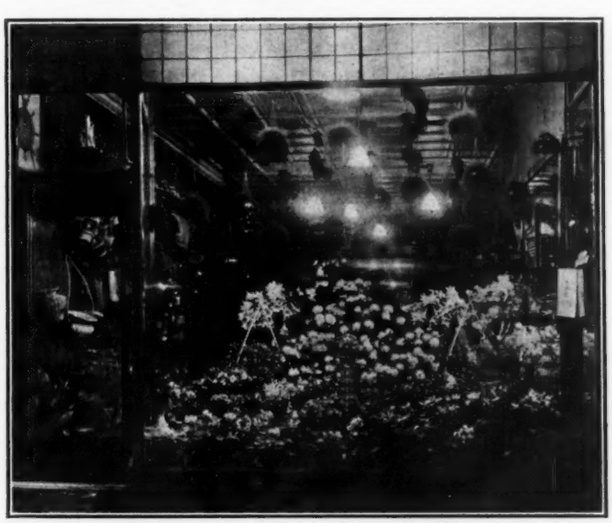
To meet this situation the detachable flush switch, illustrated herewith, has been brought out by the Metropolitan Switchboard Company, New York. It will be seen that the mechanism of this switch is in a plug form which can be withdrawn without disturbing the connections in the contact-box part, and allows a new plug to be inserted when necessary. The three parts shown, the contact box, the plug mechanism and the face plate, are packed in separate boxes. The contact box, which fits any iron outlet box, is provided with a sheet-fiber cover or filler to prevent the dirt getting into the contact box before the plug mechanism is inserted. The plug mechanism is wrapped in oiled tissue paper and packed in a strong box and need not be inserted until the decoration of the walls is finished. The face plates are of the old, familiar type except when special ones are required.

It is claimed that this switch saves money for the wiring contractor, as the accessibility of the binding post enables the wireman to connect them up quickly. The use of them also enables the contractor to finish once for all the wiring of a building and does not oblige him, as in the case of the old-style switch, to stuff the outlet boxes with paper and return to install his switches after the rough plastering is done.

To the owner of a plant it appeals at once, as former troubles with the old-style switches are done away with and a breakdown of a switch means nothing more to remedy it than to push a plug in a receptacle. As to design and workmanship, it is merely necessary to state that in an actual test one of the mechanisms was operated 31,400 times.

A Well-Lighted Store.

The store of S. A. Anderson, located at 440 Main Street, Buffalo, N. Y., illustrated herewith, is a good example of the economical and highly efficient lighting effect obtained by the use of tungsten lamps in combination with prismatic reflectors. The illustration was reproduced from an unretouched night photograph. Prior to the installation of these lamps the store was lighted by three enclosed arc lamps and the windows by means of 15 16-cp carbon-incandescent lamps mounted in a reflecting gutter. Under the old conditions the store was as well lighted as its neighbors, but since the installation of the tungsten lamps it stands out conspicuously as an example of effective illumination.



STORE WINDOW LIGHTING WITH TUNGSTEN LAMPS.

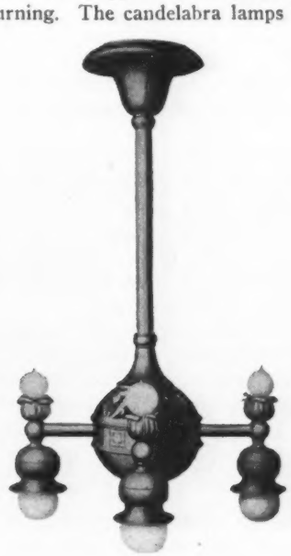
As the very practical question of cost is of vital importance in store illumination, it is interesting to compare the amount of energy consumed under the old and new conditions, bearing in mind at the same time that with tungsten lamps the quality of light is far superior to that obtained under the old conditions, being, in fact, a close approximation to sunlight. In the store there were formerly installed three 5-amp, 110-volt direct-current arc lamps, having a total current consumption of 1650 watts. The new equipment consists of four General Electric 250-watt tungsten lamps with the lower portion of the bowl frosted, and provided with satin-finished prismatic glass reflectors. They give twice the effective illumination obtained from the use of the arc lamps and with a power consumption of only 1000 watts as against 1650 watts. This is a 40 per cent saving; that is, giving a reduction of 40 per cent in the bill for the same hours' use of the lamps or less 65 per cent longer use for the same cost.

In the window 15 16-cp, 50-watt carbon-incandescent lamps were formerly used, with a power consumption of 750 watts, giving an effective illumination of 240 cp. These were replaced by three 250-watt tungsten lamps, similar to those in the store, and equipped with the same satin-finished reflectors. The power consumption in this case was the same as with the carbon lamps, namely, 750 watts, but the effective illumination was more than three times as great, being 750 cp as against 240 cp. In addition to this, it should be taken into account that the periodical disturbance caused by trimming arc lamps is altogether avoided, as the tungsten lamp has an effective life of 800 hours, and, unlike its predecessor, the carbon lamp, it will maintain its full lighting efficiency throughout its effective life. The light is not only evenly diffused, but the slight variations in voltage which occur in the average lighting circuit will not cause any flickering in the tungsten lamp.

The saving in bills for power consumption assured by the use of tungsten lamps is obvious, and it was Mr. Anderson's prompt appreciation of their many advantages that caused him to scrap the old lighting outfit in his Buffalo store and substitute tungsten lamps.

Nernst Lamp Chandeliers.

The Nernst Lamp Company has added to the line of Westinghouse Nernst chandeliers a new type equipped with candelabra lamps for instantaneous lighting. The candelabra lamps are mounted in a vertical position, one directly above each of the burners, and have the appearance of additional ornamentation when not burning. The candelabra lamps burn only while the heater tubes are in service and are automatically cut out with the heater tubes. When used on the 220-volt type chandelier the candelabra lamps are connected two in series. On the 110-volt type, they are connected in multiple. Chandeliers with this equipment are made in all the standard Renaissance and Art Nouveau designs.

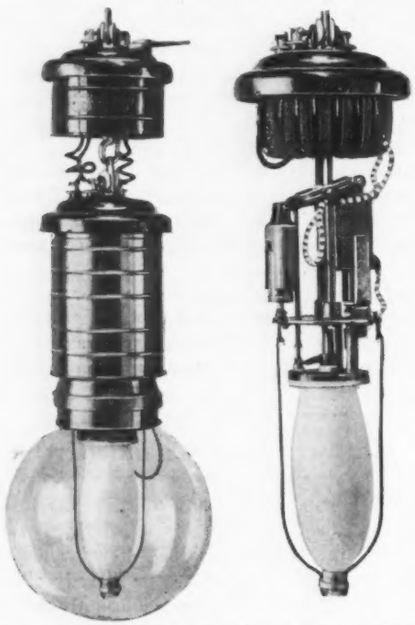


CHANDELIER.

New Arc Lamp for 25-Cycle Circuits.

As the pulsations of a 25-cycle enclosed carbon arc are visible to the eye, light emanating from such a source cannot be considered satisfactory for many classes of artificial illumination, and will not ordinarily be used in any case where a more suitable circuit is available. With the more extensive use of lower-frequency alternating current for railroad and stationary motor power, there are parks, railroad terminals, factory buildings and factory yards to be lighted. For such general illumination the 25-cycle enclosed arc is being used and considerable satisfactory. Heretofore the only enclosed arc lamp available has been a modification of some lamp designed for higher-frequency circuits, such modifications consisting of the use of extra or more flexible springs to take up the vibration of the mechanism.

Fig. 1 shows the external appearance and Fig. 2 the mechanism of a lamp designed by the General Electric Company to



FIGS. 1 AND 2.—ARC LAMP FOR 25-CYCLE CIRCUITS.

meet these exacting requirements. The frame is of the well-known two-rod type. The mechanism consists of a rocker frame carrying the lamp magnet and suitable current-adjusting counterweight. The armature is of standard laminated construction, but is stationary and held rigidly to the lamp-base casting. By the use of this considerable weight in the moving element, and by making the armature a part (mechanically) of the lamp frame, objectionable vibration is absorbed or deadened, thereby permitting the elimination of all springs. The lamp is as quiet and free from vibration in starting and operating as standard lamps for higher frequencies.

Where this lamp is to be operated on 220-volt or 440-volt circuits, an external as well as an internal compensator must be used (Fig. 1) and a third binding post placed on the lamp top, while for 110-volt circuits the lamp is self-contained.

Electric Welding Machines.

Electric welding machines are not intended to be universal in their application. The device does not take the place of a blacksmith and weld anything from a barrel hoop to a propeller shaft. The welder is a special machine designed for the manufacturer who has thousands of pieces of one kind to weld, and for this work the machine is without a peer. The Toledo Electric Welding Company, of Toledo, Ohio, manufactures a line of electric welders, each of which is suited for a particular class of work. Two of these machines are illustrated herewith. As is well known, the underlying principle of the electric welder is very simple and is an adaptation of the fact that a poor conductor offers so much resistance to the flow of electricity that intense heat is set up. The degree of heat depends on the current and the resistance. For welding purposes alternating current having a tension of about 4 or 5 volts is preferable. Electricity at this potential is easily obtained by means of the transformer, which forms part of the welding equipment. To give some idea of the power required and the time it takes

FIG. 1.—SPOT WELDER.

to make a weld, the following table for round iron and steel is appended. The time may vary from that given, as the greater the current the shorter the time.

Diameter of rod, inch.	Kw.	Time in seconds.
¼	5	5
½	8	10
¾	12	20
1	18.5	30

The power required varies for the different sizes nearly as the cross-sectional area of the material at the point where the weld is to be made. Best results are obtained when the surface is free from rust and scale. Fig. 1 shows a spot welder. In this machine two pieces of iron wire, for instance, are placed one across the other on the lower die in the form of a cross. The lever handle is pulled forward, thus forcing the upper die down until it touches the wire, the foot switch on the floor is pressed and the weld completed. Fig. 2 shows a welder for

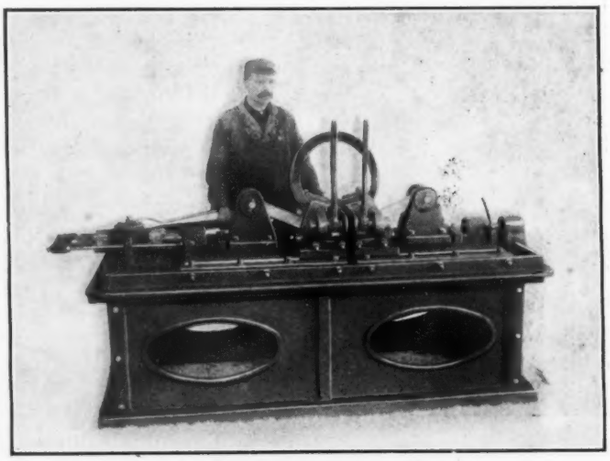


FIG. 2.—WELDER WITH HYDRAULIC RAM.

iron and steel up to 1½ in. cross-section. The machine is shown with a heavy ring in the clamping jaws. A helper inserts the stock and the man doing the welding pumps the lever shown in front which operates a 5-ton hydraulic jack to force the ends together. A weld is made in 40 seconds and the work is accurate and uniform.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Conditions of trade during the past week have shown very little improvement. In all lines there seems to be a disposition to delay. Every one is waiting until after the tariff is definitely settled, and many opinions are expressed that there will be no satisfactory volume of business until the fall. It is not the reduction in the tariff rates that has brought about this condition so much as the uncertainty. When once settled, manufacturers and merchants will adjust themselves to the new conditions, and business will proceed upon the new basis. It is the general opinion that this basis will be lower than that which has prevailed in recent years, and that the price of labor will necessarily be reduced. Whether the process of readjustment will bring about strikes and disturbances is a question. It is believed, however, that no serious disturbances will occur. In jobbing and wholesale lines the limited business done during the past week has been purely from hand to mouth, and only fill-in orders and orders for absolute necessities are being received. In the industrial field there is very little business being transacted. The equipment situation is unimproved, and, while many railroads have plans perfected for large orders, few are being placed. The electrical companies report the same condition of affairs, and say that, while there is good business in prospect, little is being received at this time. The crop situation is entirely satisfactory, and the promise of abundant yields was never better at this season of the year. Railroad earnings continue to show increases over the same period last year, and net earnings are vastly improved, owing to the economies of operation. Collections continue to be only fair, but there are few business troubles to disturb trade. Business failures for the week ended March 25, as reported by *Bradstreet's*, were 226, compared with 224 in the previous week, 286 in the similar week of 1908, 166 in 1907, 169 in 1906 and 227 in 1905.

THE COPPER MARKET.

There has been some revival of speculative activity in standard copper warrants in the London market during the past week. This activity it is believed has been mainly for the American account, and has resulted in a material advance in the prices of futures, with a consequent strengthening of the tone of the entire market. In addition to this there has been a trifle more activity in buying for consumption in this country. This buying has been principally for wire drawers and brass manufacturers, and, while it has not been extensive, has had the effect of encouraging producers and putting up prices. During the week there has been an advance of from ¼ to ⅜ cent through the entire list, and copper sellers continue to refuse to make contracts for round lots for future delivery. Thus it will be seen that the condition of the copper market appears to be materially improved, in spite of the fact that buying continues to be abnormally light and production continues to be unprecedentedly heavy. Exports have been a trifle greater during March than in February, and will probably amount to 50,000,000 lb., and domestic consumption will be in the neighborhood of 40,000,000 lb., making the total takings for the month about 90,000,000 lb. As the production and imports will easily amount to 110,000,000 lb. there will be an apparent accumulation of 20,000,000 lb. This addition will bring the Copper Producers Association's figures of "marketable copper" up to near 200,000,000 lb. It is generally believed that the actual amount of copper in sight in this country is far greater. While there has been a continuance of the talk of curtailment that has been intermittently heard since the beginning of the year, it is highly improbable that such a course will ever be undertaken. The producers who can market copper at 10 or 11 cents, at a profit, have no disposition to close their plants, or to shorten output, in order to protect their brethren who cannot pay expenses at 12 cents. Concerted action is therefore absolutely out of the question. On the other hand, the producers whose cost is highest are for the most part very extensive establishments, and are held by powerful financial interests. For these it is better business to continue operations at a small loss rather than close. The latter course means a continuance of carrying charges and a disintegration of working forces. During the past week there has been a revival of the talk of forming a new metal exchange or at least abandoning the present institution, but nothing has so far come of it. At the annual meeting of the Exchange, March 29, the, so-called, administration ticket was re-elected without organized opposition. Only 74 votes were cast, and P. R. Jennings was chosen president. Exports of copper for March, including March 29, have been 20,454 tons. Quotations on the Metal Exchange March 29 were:

Lake	12⅞	@	13
Electrolytic	12½	@	12⅝
Casting	12¼	@	12⅜

London prices were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	57 1 3	56 17 6
Standard copper, futures	57 16 3	57 12 6
Market	Firm	Easy
Sales of spot		250 tons
Sales of futures		2,500 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

ELECTROCHEMICAL ENGINEERS AND EXPERTS.—Messrs. Delton, Mailloux & Company announce the establishment of offices in Paris and in New York, and that they are prepared to undertake all kinds of electrochemical engineering and expert work. M. Henri Delton has an established reputation in Europe as an electrochemical engineer of ability and experience. He has been identified with many important electrochemical industries there and has had occasion to design, construct and operate numerous electrochemical plants for different purposes. He is retained as the technical adviser and the consulting engineer of several electrochemical concerns in various countries. Mr. C. O. Mailloux's success and reputation and his large clientèle as a consulting electrical engineer are adequate evidence of his extended and diversified experience in electrical engineering and construction work of all kinds. The announcement states that the firm has at its disposal the experience and data of numerous electrochemical plants and processes of all kinds. The firm can thus predetermine costs and results with certainty and is in a position to design new plants or redesign and modernize existing plants with precision. It will also assist clients in the development of new processes and methods or in introducing them in various countries, and, in general, is ready to place its knowledge, experience and facilities at the disposal of those who have electrochemical problems of any kind to solve and who wish to attain practical, industrial or commercial results in the shortest time and with the least expense.

GENERAL ELECTRIC COMPANY EQUIPS ELECTRIC HOTEL.—The Stanley Hotel, at Estes Park, Col., is to be operated entirely by electricity. F. O. Stanley, the proprietor, is sparing no expense in the equipment of the house, and has acquired his own water-power, which, at a distance of four miles, will provide enough electric energy to not only supply all of the electricity for use in the hotel, but for his own private residence and other cottages in Estes Park; street lighting will also be supplied from the same source. Mr. Stanley is determined to make this hotel representative of the latest ideas in applications of electricity, and has ordered from the General Electric Company a complete electrical equipment for his kitchen and laundry. When open for regular service this summer the hotel will be "up to the minute" in all of its electrical appointments. The hotel is designed to accommodate between 200 and 300 guests.

EXTENDING WIRELESS IN THE GREAT LAKES.—Just at the present time there appears to be a tremendous development in the direction of equipping the shipping of the Great Lakes with wireless telegraph apparatus. The United Wireless Company has recently made contracts to install upon the Graham & Morton fleet of steamers its apparatus, and has in prospect contracts with several other large steamship companies operating in the same waters. Stations for overland and lake service are being established at many points on the shores of the lakes, and are expected to be in operation shortly after navigation is entirely opened. The following cities have been definitely decided on for wireless stations, being the principal ports by the lake traffic: Duluth, Chicago, Milwaukee, Manitowoc, Wis., Benton Harbor, Holland, Grand Haven, Ludington, Petoskey, Macinac Island, Sault Ste. Marie and Detroit, Mich.; Toledo and Cleveland, Ohio, and Buffalo, N. Y. A representative of the United company says that many other stations will be equipped during the coming summer. It is intended by the company to develop an extensive inland service in this section of the country, and it is believed that commercial messages will be transmitted in sufficient quantity to make the investment a paying one. In this locality the United company is adding to the capacity of its Waldorf-Astoria station. This will be made a 5-kw station, with the wires elevated upon high steel towers. It is expected that under favorable conditions this station will be able to communicate with Havana and Porto Rico.

SISKIYOU ELECTRIC POWER COMPANY.—The Siskiyou Electric Power Company, Yreka, Cal., has recorded claims to 450,000 in. of water of the Klamath River, to be taken at two points about half a mile distant from the present power plant on Fall Creek. Alex. J. Rosborough, secretary of the company, is the claimant. The water location carries the entire flow of the river at low water. The company will begin work soon on a new power plant which is to be completed within three years and which will have a capacity of 60,000 hp. The plant will be located at Ward's Canyon and will necessitate a tunnel for the gravity line. The company's present plant at Fall Creek is developing about 6000 hp, but will soon be insufficient to meet the demands upon it.

LONG ISLAND RAILROAD TO BUY $2,000,000 MOTOR CAR EQUIPMENT.—Specifications have been prepared by the Long Island Railroad and bids will soon be asked for 120 steel passenger motor cars. These cars with their motors will cost in the neighborhood of $2,000,000. They are intended for service through the Pennsylvania tunnels under the East River, which it is now promised will be completed in the spring of 1910. Only steel cars will be used in these tunnels and in the suburban service in Long Island territory adjacent to New York.

CHICAGO ELECTRICAL WORK IN PROSPECT.—Among the Chicago concerns which are preparing to build new electric plants or extensions to old ones, for which engines, generators, motors, switchboards and other equipment will be required, are the W. M. Hoyt Company, Hart, Schaffner & Marx, the Chicago Reduction Company and the Gutmann Company, tanners. Mr. Martin C. Schwab, 161 State Street, Chicago, is the consulting engineer for all of these plants.

BERGMANN TUNGSTEN LAMPS.—The P. H. Klein, Jr. Company, 110 Liberty Street, New York, is introducing the "Wolfram" tungsten lamps in the 25-watt size, which gage is now regularly made at the Bergmann Electrical Works of Berlin, Germany, of which the Klein company is the U. S. representative. This new lamp corresponds in size and shape to the ordinary 16-cp carbon filament lamp, and can be burned in any position.

YORK (PA.) HYDRO-ELECTRIC PLANT.—C. C. Spahr, a leading contractor of York, Pa., has purchased the water rights on Connewaga Creek, three miles from Wellsville, York County, Pa., where he will install a water-power plant. A concrete dam is built across the creek, and there is sufficient water at all stages to generate 150 to 200 hp. It is estimated that the plant when completed will cost approximately $25,000.

ELECTRIC MOTOR FOR A PAPER MILL.—The Raymondville Paper Company, Raymondville, N. Y., will add four motor-driven pulp grinders to its electrical equipment. Electrical energy for the plant is transmitted from the hydro-electric station at Massena Falls.

ELECTRICALLY EQUIPPED COLD STORAGE PLANT.—A consular report states that the Arcadia Cold Storage Company, of Halifax, N. S., has been organized to build a $500,000 cold storage plant which will be electrically equipped.

NAVAL PROPOSALS.—The U. S. Navy Department is asking proposals for the supply of 11 induction motors, to be delivered at the Norfolk Navy Yard. Bids will be opened April 9.

Financial Intelligence.

THE WEEK IN WALL STREET.

Trading in stocks during the past week has been on a relatively small scale. The daily transactions have averaged less than 500,000 shares until March 29, when there was a spurt of activity, and there has been small interest displayed, either among the speculators or investment buyers. The tone of the market continues to be strong and the net changes recorded have been, almost universally, advances. One of the striking features of the market is the stubbornness with which the active list resisted the sudden demoralization of traction stocks. When Interborough-Metropolitan preferred broke 7 points within a few hours, and Third Avenue sold off 6 points, the balance of the list maintained its steadiness, and in many cases actually advanced. It is pretty thoroughly understood that there will be little activity in trading until the settlement of the tariff question. There is to be no general resumption of business until the new basis is adopted, and, in the last analysis, the stock market is entirely dependent upon actual business. There has always been an opinion that the gross earnings of railroads are something of a barometer. These are certainly encouraging at the present time. In both January and February the gross earnings have materially increased. The fact that net earnings have increased is not so important, because it is well known that there have been rigid cuts in the charges for maintenance and improvements. This latter fact, however, is in itself hope-inspiring, from the fact that when the railroads begin to buy again they will need large quantities of equipment. Copper stocks continue to be surprisingly strong in view of the statistical position of the metal market. This is attributed by many to manipulation, but it is more likely due to the confidence speculators have in the ability of the financial interests behind the copper producers to maintain prices, even in the face of reduced consumption. The money market continues easy, and the demand for bonds is good. Rates quoted March 29 were: Call, 1½@2; 90 days, 2½@2¾ per cent. The quotations in the table are those of the close March 29.

NEW YORK.

	Mar. 22.	Mar. 27.	Shares sold.		Mar. 22.	Mar. 27.	Shares sold.
All.-Ch.	13⅝*	14⅜	1,732	Int.-Met., pfd.	42⅛	40	58,840
All.-Ch., pfd.	43	45⅞	1,900	Mackay Cos.	72⅛*	73½	300
Amal. Cop.	70½	74⅜	127,200	MackayCos.,pfd.	71*	71¼	126
Am. D. T.	35*	35*	——	Manhattan Elev.	142⅜*	144	400
Am. Loc.	52	54¼	5,350	Met. St. Ry.	28*	21*	150
Am. Loc., pfd.	111½*	114*	12,400	N.Y. & N.J.Tel.	116	117¼*	460
Am. Tel. & Cbl.	76½*	76½*	——	Steel, com.	44¾	47⅛	253,900
Am. T. & T.	130	132¼	12,400	Steel, pfd.	110½	112⅝	9,023
B. R. T.	72⅛	74⅝	30,170	W. U. T.	65	66⅞	2,200
Gen. Elec.	153½*	157½	4,700	West'h., com.	79*	83⅜	4,480
Int.-Met., com.	14¼	13	28,600	West'h., pfd.	115	115*	——

PHILADELPHIA.

	Mar. 22.	Mar. 27.	Shares sold.		Mar. 22.	Mar. 27.	Shares sold.
Am. Rys.	45¾	45¾	——	Phila. Elec.	11⅝	11⅞	——
Elec. Co. of A.	12¼	12½	——	Phila. R. T.	27⅞	28⅛	——
Elec. Stor. B'ty	46⅝	46½	——	Phila. Traction.	92¼	92½	——
E. S. B'ty, pfd.	49*	49*	——	Union Traction.	53¾	54⅛	——

CHICAGO.

	Mar. 22.	Mar. 27.	Shares sold.		Mar. 22.	Mar. 27.	Shares sold.
Chi. City Ry.	187*	187*	——	Chi. Tel. Co.	133	132¼	——
Chi. Rys., Ser.1.	111*	110*	——	Met. El., com.	19*	19*	——
Chi. Rys., Ser.1.	110*	110*	——	Nat'nal Carbon.	85½*	85½*	——
Com. Edison.	111½	111½	——	Nat. Carb., pfd.	119*	119*	——
Chi. Subways.	26	27½	——				

BOSTON.

	Mar. 22.	Mar. 27.	Shares sold.		Mar. 22.	Mar. 27.	Shares sold.
Am. Tel. & Tel.	130	132⅛	——	Mex. Tel.	2½*	2¾	——
Com. Tel.	127⅛*	126¼	——	Mex. Tel., pfd.	5*	6⅝	——
Edison El. Ill.	254	254	——	N. E. Tel.	134½	132½	——
Gen. Elec.	154	158	——	W. Tel & Tel.	7*	7*	——
Mass. Elec. Ry.	14¾*	15	——	W. T. & T., pfd	77¾	77	——
Mass. E. R., pfd	71	72½	——				

*Last price quoted. Shares sold are for week March 22 to March 27.

DIVIDENDS.

Bell Telephone Company of Missouri, quarterly, 2 per cent, payable April 1.

Bell Telephone Company of Pennsylvania, quarterly, 1½ per cent, payable April 15.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable April 7.

Chicago Telephone Company, quarterly, 2 per cent, payable March 31.

Electric Storage Battery Company, preferred and common, quarterly, ¾ per cent on each issue, payable April 1.

Manchester (N. H.) Traction, Light & Power Company, quarterly, 2 per cent, payable April 15.

Mexican Telephone & Telegraph Company, semi-annual, 2½ per cent, payable May 1.

Mexican Telegraph Company, quarterly, 2½ per cent, payable April 14.

National Light, Heat & Power Company, quarterly, 1¼ per cent, payable April 1.

New England Telephone Company, quarterly, 1½ per cent, payable April 15.

New York & New Jersey Telephone Company, quarterly, 1¾ per cent, payable April 15.

Philadelphia Company, common, quarterly, 1½ per cent, payable May 1.

Scranton Electric Company, preferred, quarterly, 1½ per cent, payable April 1.

Trinidad Electric Company, Limited, quarterly, 1¼ per cent, payable April 10.

J. G. White & Company, preferred, quarterly, 1½ per cent, payable April 1.

MERGER OF ELECTRICAL CAR LIGHTING PROPERTIES.—The United States Light & Heating Company, which was incorporated in January under the laws of Maine, for the purpose of taking over several electric car-lighting properties, has completed its organization. The authorized capital of the new company is $17,500,000, consisting of $2,500,000 7 per cent cumulative preferred and $15,000,000 common. No bonds are authorized. The company has taken over the Bliss Electric Car Lighting Company, of Milwaukee, the National Battery Company, of Buffalo, and the United States Light & Heating Company, of New Jersey, which has a plant at 22 Thames Street, New York City. The new corporation begins life with a very impressive board of directors and officers, and, according to a prospectus which has been issued, offers promise of handsome returns to investors. The directors are: Edwin Hawley, president and director of a number of railroads; Julius E. French, chairman of the board of directors of the Railway Steel Spring Company; William H. Silverthorn, president of the Railway Steel Spring Company; Theodore P. Shonts, president of the Interborough-Metropolitan; Newman Erb, president, Wisconsin Central Railroad Company; Charles A. Starbuck, president of the New York Air Brake Company, and Walter S. Crandell, who is connected with the firm of Hawley & Davis. The prospectus above referred to says that of the $17,500,000 capital stock $1,000,000 preferred and $4,500,000 of common will be retained in the treasury. It is also stated that it is intended to produce a working capital of $267,000. The object of the incorporation is set forth as the manufacture of electric light apparatus in which the generating power is obtained from the car axle. It is also announced that the United States Light & Heating Company, of New Jersey, is the owner of a patent roller-bearing power transmission in which the strain is taken away from the armature. These are Moscowitz patents. Through the National Battery Company the new concern expects to obtain its storage batteries at a saving. It is also claimed that 35 railroads are prepared to install the company's lighting service. One source of revenue, according to the prospectus, is the sale of the patent rights in foreign countries, which it is estimated will realize the sum of $6,000,000. The net revenue of the company after paying the dividend on the preferred stock is figured at $1,125,000. The Cutler-Hammer Manufacturing Company, of Milwaukee, owned by the Bliss Company, and interests closely identified with it owned the National Battery Company. It is stated, however, that the Cutler-Hammer Company has no connection with the new organization unless it be in the relation of stockholder. The officers of the new company are W. H. Silverthorn, president; Julius E. French, first vice-president; Edwin Hawley, second vice-president; C. A. Starbuck, third vice-president, and W. S. Crandell, secretary and treasurer. The company expects to have a plant and be in operation within a few months; in the meantime the plants of the subsidiaries are being operated.

PUBLIC SERVICE INVESTMENT COMPANY.—Stone & Webster, Boston and New York, have organized under the laws of Maine a holding corporation under the title of Public Service Investment Company, for the purpose of taking over the firm's holdings in seven important public service corporations. The new company will have a capitalization of $1,000,000 preferred and $2,000,000 common stock, the former being 6 per cent cumulative. The entire capital stock of the new company, except five shares necessary to qualify directors, will be issued to Stone & Webster in payment for the following securities now owned by that firm: Jacksonville Electric Company, common stock, $350,000; the Minneapolis General Electric Company, common stock, $350,000; Houghton County Electric Light Company, common stock, $500,000; Pacific Coast Power Company, capital stock, $700,000; Columbus Electric Company, preferred stock, $100,000; the Seattle Electric Company, common stock, $100,000; Tampa Electric Company, capital stock, $75,000; total, $2,175,000. The securities of the new company are being offered in blocks of 10 shares of preferred and four shares of common for $950. The present earnings of the securities transferred are at the rate of $104,750 per year, which is sufficient to pay the 6 per cent on the preferred and 2 per cent on the common, leaving a small surplus. Speaking of the purposes of the new organization, a representative of Stone & Webster said: "We took this method of bringing some fresh capital into our enterprises. We preferred to organize a holding company and sell some of its securities rather than dispose of any of our holdings in the corporations we are operating. All of the stock of the new company has been subscribed and the members of the Stone & Webster firm hold control."

McCALL'S FERRY POWER COMPANY.—An eminent domain bill has been introduced in the Pennsylvania Legislature giving the McCall's Ferry Power Company permission to consolidate electric lighting companies. It is said that a plan is on foot to combine many of the light and traction companies of southeastern Pennsylvania. Philadelphia and New York capitalists are back of the plan which includes the hydro-electric plant at McCall's Ferry on the Susquehanna River. More than $10,000,000 has been expended already in building the dam and installing machinery. It is intimated in Philadelphia that the Pennsylvania Railroad will make use of the energy generated to operate its trains between Harrisburg and Philadelphia. Inquiry at the main office of the McCall's Ferry Power Company in New York, brought forth the response that at this time the officials of the company were unwilling to give out any information concerning their future plans.

NEW YORK STATE RAILWAYS.—The New York State Railways, with offices at Rochester, has been organized to take over the electric lines known as the Vanderbilt System in central New York. The capital of the new company is placed at $23,240,200. A certificate has been filed with the Secretary of State at Albany showing that the new company had consolidated the Rochester Railway, the Rochester & Sodus Bay and the Rochester & Eastern Rapid Railway companies. The officers of the new holding company are Horace E. Andrews, president; William K. Vanderbilt, Jr., and John J. Stanley, vice-presidents; Edward L. Rossiter, treasurer, and Joseph C. Collins, secretary. William C. Brown, president of the New York Central Railroad, is a member of the board of directors.

PIONEER TELEPHONE & TELEGRAPH COMPANY.—The report of the Pioneer Telephone & Telegraph Company, of Oklahoma, for the year 1908 shows gross earnings of $1,356,703 against $1,125,388 for the previous year. In spite of this increase, the net earnings declined more than $20,000 and the surplus was only $22,751 against $63,945. The president of the company reports that owing to the depressed condition of business during the year it was deemed unwise to make any larger extensions and improvements than were absolutely necessary to protect the property. As soon as business conditions are improved the management of the company expects to extend its service to meet all the demands of the public that the company serves.

SAO PAULO TRAMWAY, LIGHT, HEAT & POWER COMPANY.—The directors of the Sao Paulo (Brazil) Tramway, Light, Heat & Power Company—the stock of which is largely held in Montreal—will issue $1,500,000 new common stock, bringing the issue up to $10,000,000. It is intended to divide the stock later into part preferred and part common.

CORTELYOU HEADS CONSOLIDATED GAS.—George B. Cortelyou, former Secretary of the Treasury, has been elected president of the Consolidated Gas Company of New York. The stock of the company has been constantly advancing recently, and it is now stated that the 80-cent rate will not interfere with the company's power to earn full dividends.

METROPOLITAN REORGANIZATION PLANS.—No definite plan for the reorganization of the properties formerly in the Metropolitan Street Railway System has yet been announced, and it is doubtful if any has been agreed upon. A man connected with the reorganization committee is authority for the statement that, while some progress has been made on a plan of reorganization, nothing can yet be announced as to the scheme nor the means by which it will be financed. No plan, he said, contemplated any attempt to delay the foreclosure sale set for June 1. He indicated that the reorganization committee would attempt to buy the property at this sale. It is pretty well understood that the Interborough-Metropolitan Company has sold its holdings of Third Avenue stock in the open market, and that it received a price considerably in advance of present quotations. It is taken that the money thus secured will be used as a basis for the fund necessary to protect the company's holdings of Metropolitan Street Railway stock. The surface lines on Manhattan are now doing an excellent business, and the introduction of pay-as-you-enter cars has materially increased receipts. It is believed that upon a reasonable capitalization satisfactory dividends can be earned.

AMERICAN LIGHT & TRACTION COMPANY.—The executive committee of the American Light & Traction Company has recommended to the board of directors that a stock dividend of 10 per cent be paid in November of this year. The effect of this recommendation has been to rapidly advance the price of the shares on the curb market in New York. This price has gone up 24 points within the past week. Emerson McMillan, president of the company, says that the company's earnings have been equal to the most sanguine estimates of the directors. On the present earnings the rate of 8 per cent cash and 10 per cent in stock can be continued indefinitely. The board of directors intends to declare this 10 per cent stock dividend annually in February, from the balance in the treasury. Of the $15,000,000 in common stock shares only $8,239,300 has been issued. This leaves a sufficient amount to continue the annual 10 per cent distribution for more than seven years.

NEW ENGLAND TELEPHONE COMPANY.—The requirements for extensions and additions to the New England Telephone Company have been already financed for one and a half years ahead. It is estimated that the construction requirements for the fiscal year, which began Jan. 1, will amount to $1,700,000, and for 1910, $1,800,000. To meet these requirements the directors have decided to issue $3,563,400 additional stock at par. Half of this amount will be available by the middle of July and the balance by next January. The new stock is to be issued in the ratio of one share of new for each 10 of old. This gives to the present stockholders rights which are estimated to be worth from $2 to $2.50 per share.

GREAT WESTERN POWER COMPANY.—The California Electric Generating Company has organized in California in connection with the Great Western Power Company for the purpose of building and operating the latter's steam power plant in Oakland. This plant will be leased to the Great Western Power Company and will be operated in connection with the Great Western hydro-electric power plant on the Feather River. The company has $2,500,000 preferred stock authorized, of which $600,000 is issued, and $5,000,000 common stock, all issued. Beginning Jan. 1, 1913, the Great Western Power Company guarantees the 6 per cent dividends on the preferred stock.

CAR LIGHTING & POWER COMPANY.—The Car Lighting & Power Company has been incorporated under the laws of Maine by the reorganization committee of the Consolidated Railway, Lighting & Refrigerating Company, to take over the property of that company, which was recently purchased at receiver's sale by the committee. The capital stock of the new company will be $8,000,000, divided into shares of $25 each. The properties which are acquired by the new company are: The Consolidated Railway, Electric Lighting & Equipment Company, Lindstrom Brake Company and Railway & Stationary Refrigerating Company.

MEXICAN TELEGRAPH COMPANY.—The annual report of the Mexican Telegraph Company for 1908 shows a decline in gross earnings of about 22½ per cent from those of the previous year. Returns, however, were greater than for any year before 1907. Since the first of the present year conditions are said to be improving. The gross receipts for last year were $811,342, and the surplus remaining after the payment of dividends, etc., was $324,612. Regular quarterly dividends at the rate of 10 per cent per year were paid on the common stock.

CENTRAL & SOUTH AMERICAN TELEGRAPH.—The report of the Central & South American Telegraph Company for 1908 shows a decrease in earnings from the previous year and an increase over any year prior to 1907. The gross receipts for the year were $1,664,506. After paying $574,260 in dividends and the fees to the Mexican Government, there was left $328,527 to be added to the surplus. This company was incorporated in New York, and owns and operates cables and telegraph lines in Mexico and Central America.

WESTINGHOUSE PROFITS IN RUSSIA.—The balance sheet of the Westinghouse Company in Russia for its ninth year shows a net profit of 191,742 rubles (almost $99,000). The company has a capital of 300,000 rubles. It is not part of the program to pay any dividend at this time.

MASSACHUSETTS LIGHTING COMPANIES.—The gross earnings of the Massachusetts Lighting Companies for the month of February were $65,079, compared with $56,405 last year, an increase of $8,673.

HOLLISTER (CAL.) LIGHT & POWER COMPANY SOLD.—The Great Western Power Company, of California, has purchased the property and power plant of the Hollister Light & Power Company.

DAN RIVER POWER & MANUFACTURING COMPANY.—The capital stock of the Dan River Power & Manufacturing Company, Danville, Va., has been increased from $3,000,000 to $3,500,000.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—An abstract of the annual report of the American Telephone & Telegraph Company for 1908 will be found in the front part of this issue.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Telephone & Telegraph Company:					
Year 1908	$27,898,970	$2,003,956	$25,895,013	$7,773,306	$18,121,707
Year 1907	25,609,671	2,130,381	23,479,290	7,209,902	16,269,387
Central & South American Telegraph Company:					
Year 1908	1,664,506	677,160	987,346	574,260	328,528
Year 1907	1,749,045	556,666	1,192,379	551,031	607,936
Cumberland Telephone & Telegraph Company:					
February, 1909	524,412	311,946	212,466	42,627	169,839
February, 1908	511,848	285,980	225,868	37,552	188,315
Detroit United Railway Company:					
February, 1909	519,592	348,711	170,881	154,457	27,146
February, 1908	465,526	332,046	133,480	135,122	2,671
Mexican Telegraph Company:					
Year 1908	811,342	199,719	611,623	287,010	324,613
Year 1907	1,047,531	182,163	865,368	287,010	578,358
Milwaukee Light, Heat & Traction Company:					
February, 1909	100,255	29,281	70,975	59,929	11,046
February, 1908	94,726	29,505	65,221	55,980	9,241
Minneapolis General Electric Company:					
January, 1909	105,640	41,123	64,517	30,222	34,295
January, 1908	93,936	38,846	55,090	30,046	25,043
Pioneer Telephone Company, Oklahoma:					
Year 1908	1,356,703	1,187,852	168,851	146,100	22,751
Year 1907	1,125,388	935,968	189,420	125,475	63,945
Schenectady Railway Company:					
Quarter Ended Dec. 31, 1908	213,243	152,441	53,338	.....	.....
Quarter Ended Dec. 31, 1907	246,272	167,054	74,201	.....	.....
Seattle Electric Company:					
January, 1909	402,811	250,293	152,517	86,727	65,790
January, 1908	365,750	239,585	126,165	75,843	50,321
Twin City Rapid Transit Company:					
February, 1909	483,101	273,784	209,317	133,963	75,354
February, 1908	453,944	253,644	200,300	122,789	77,511

GENERAL NEWS

Construction News.

BREWTON, ALA.—The citizens on March 20 voted to issue additional bonds, the proceeds to be used for installing new machinery in the municipal electric light and power plant.

CAMP HILL, ALA.—The proposition to issue bonds for an electric light plant will be voted upon at the coming election.

DOTHAN, ALA.—The City Council is considering an ordinance providing for an issue of bonds for extensions to the water, light and sewer systems.

PHOENIX, ARIZ.—An election will be held within 30 days to vote on the proposition to grant franchises to a competing telephone company and to a suburban motor railway. Dr. Foss is president of the telephone company and E. J. Bennett is promoter of the railway.

PHŒNIX, ARIZ.—The Board of County Commissioners has granted a franchise to T. N. Clanton and H. E. Kell to erect and operate a telephone system in Buckeye Valley, extending from Agua Fria River to the lower end of what is known as Arlington County.

MORRILTON, ARK.—The Home Telephone Company will make improvements to its system, including the installation of a new switchboard, at a cost of $1,250. E. J. Massey is manager.

BODIE, CAL.—James S. Cain is promoting a project to develop two water powers capable of developing 30,000 hp, one of which is located on Rush Creek and the other on Leevining Creek. It is proposed to utilize the power to generate electricity to be distributed within a radius of 100 miles if sufficient number of contracts for power can be placed. It is said that the owners of the South End Consolidated, the new Bodie Snow Drift, Golden Star, Golden Harp and other mines have agreed to place contracts for power; the mills and mines at Aurora will also take electricity, and the lines will probably be extended from there to other mines and camps.

DOWNEY, CAL.—J. R. Gordan, proprietor of the local electric light plant, is planning to extend his transmission lines to Rivera, Norwalk and Artesia as soon as possible.

FRESNO, CAL.—Preliminary action has been taken by the Board of Supervisors to enable the San Joaquin Light & Power Company, of Fresno, to make important extension of its transmission lines in various parts of the county. The first transmission line of the company will be extended from the Fresno copper mines through the Academy country and thence to Sangor, a distance of 19 miles; the other extension will consist of a second wire out of the Fresno substation to connect with the town of Clovis.

PLACERVILLE, CAL.—Notice of appropriation of 15,000 inches of water in the south fork of the American River has been filed by H. C. Marsh, to be utilized for irrigation, mining, municipal purposes, and to generate electricity.

QUINCY, CAL.—The Round Valley Water Company has been granted a franchise by the Board of Supervisors to construct transmission lines through the streets of Indian Valley and along the highways of Indian Township for the distribution of electricity.

RED BLUFF, CAL.—Notice of appropriation of 10,000 cu. in. of water to be taken from Mill Creek has been filed by A. T. Foward. The water will be used for power and domestic purposes.

RED BLUFF, CAL.—The Sierra Electric Company, which was recently granted a franchise in Red Bluff, proposes to build two power plants, the first of which will be located on Digger Creek, above Manton, and will have an output of 2000 hp. The second plant will be located some distance below the first and, utilizing the water again, will have the same output as the first plant. Both plants can be increased to 3000 hp each if needed. The county is to receive 2 per cent per annum of the gross receipts of the company after it has been in operation five years.

REDLANDS, CAL.—An agreement has been entered into by the stockholders of both the Edison Electric Company, of this city, and the Home Gas & Electric Company, whereby the former takes over all of the electric business of the city and the plant of the Home company, and the Home company takes over the gas plant and gas business of the Edison company, with the privilege of taking also the gas plant and business of the Edison company in Riverside. The entire transfer is to be completed within a short time. The Home company began business Jan. 1, 1906. John B. Miller, of Pasadena, Cal., is president of the Edison company, and W. L. Frost is the local manager. W. R. Cheney is president of the Home company, and C. S. Chesnut is general manager.

SAN BERNARDINO, CAL.—Bids will be received by the Board of Supervisors for a 50-year franchise granting the right to erect a telephone and telegraph system in this city. Charles Post is county clerk.

SAN JACINTO, CAL.—We are informed that Roach & Chambers, owners of the local electric light plant, contemplate disposing of their plant in the near future.

WASHINGTON, D. C.—Bids will be received until April 6 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Philadelphia, Pa.: Schedule 1051—Two electric deck winches. Brooklyn, N. Y.: Schedule 1041—Equipment for electrically driven coaling gear machinery, with appurtenances, for U. S. S. *Florida*. Schedule 1042—Five complete sets of turret turning equipment; five complete sets of mechanical variable-speed gear equipment, and five sets of electric equipment for the U. S. S. *Florida*. Schedule 1043—Three ash-hoisting engines for U. S. S. *Florida*. Schedule 1046—Erecting steel foundation for turbo-generator set; fabricating and erecting the steel operating floor around turbine power plant. New Orleans, La.: Schedule 1052—Twelve copper-shell multiple direct-current arc lamps; main cut-out panel board and distribution cabinet, and two panel boards and distribution cabinet; cotton-covered lamp cord and rubber-covered and waterproof wire; conduits; 50 conduit elbows and 2750 ft. conduit, with couplings; junction boxes, bushings, etc. Bids will also be received at the same place until April 13 as follows: Mare Island, Cal.: Schedule 1037—Two chain ammunition hoist motors, with spare parts. Application for proposals should designate the schedule desired by number.

ATLANTA, GA.—The State Railroad Commission has authorized the Piedmont Power Company to issue $3,000,000 in bonds. The company was recently organized to develop water power in the vicinity of Tallulah Falls, on the Tugaloo River, in North Georgia. Louis Magid is president.

DOUGLASVILLE, GA.—The town has voted a bond issue of $10,000 for an electric light plant in preference to granting a franchise to a private corporation.

JACKSON, GA.—The Flovilla & Indian Springs Railway has applied for a franchise to construct and operate its railway.

MACON, GA.—O. R. Nolan and others have filed a bill in the courts to cause the Central Georgia Power Company to be enjoined from proceeding with the construction of its large plant at Capps and Lloyd shoals, near Jackson, Ga. The power company has served notice that it will proceed to condemn a portion of the land of the complainants near the power plant. The State court set the third Monday in April for the hearing, but did not enjoin the construction of the dam.

MANCHESTER, GA.—Contracts for the construction of buildings for the Manchester Cotton Mills have been awarded to Pike Brothers, of La Grange, Ga. The company will let contracts April 5 for its 1000-hp power plant. The cost of the entire plant is estimated at $600,000. A. L. Walker, Austell Building, Atlanta, Ga., is engineer.

TOCCOA, GA.—Plans are being made by J. D. Prather, of Toccoa, and C. G. Rolston, of Pittsburgh, Pa., for the construction of a dam on Tugalo River. The cost of the dam is estimated at $150,000.

VALDOSTA, GA.—At an election to be held April 14 the citizens will vote on the proposition to issue $30,000 in bonds, the proceeds to be used to enlarge and extend the street lighting system.

WAYCROSS, GA.—The City Council is considering the question of installing an electric light plant to be operated in connection with the water works system.

WAYCROSS, GA.—The City Council has declared forfeited the franchise of Loomis, Pettibone and others for gas and electric plants and an electric railway system, the Council claiming non-compliance and demanding the $6,000 bonds given as evidence of good faith. A committee has been appointed to investigate the matter and report at the next meeting of the Council.

CAMBRIDGE, IDAHO.—The Cambridge Development Company is contemplating developing the water power of Rush Creek Falls, to be utilized to generate electricity for lamps and motors in Cambridge, and later to extend its transmission lines to other towns. It is proposed to tap the creek just above the falls, where a fall of 100 ft. can be secured by running a pipe line of 500 ft. The company would like to interest some one with capital in this enterprise. For further information address D. H. Clare, Cambridge, Idaho.

MULLAN, IDAHO.—The capital stock of the North Idaho Telephone Company has been increased from $25,000 to $100,000.

CHICAGO, ILL.—The remodeling of the lighting plant at the University of Chicago is under consideration. Harry Pratt Judson is president of the university.

COLUMBUS, IND.—The Central Indiana Light Company has awarded a contract to the Westinghouse-Church-Kerr Company for the construction and equipment of a new power plant. The plant will furnish electricity for the street railway system and also for lamps in this city.

GREENCASTLE, IND.—The City Council favors the granting of a franchise to a new company which proposes to construct and equip a new electric light and power plant in this city.

INDIANAPOLIS, IND.—The Indianapolis Light & Heat Company has awarded a contract to the General Electric Company, Schenectady, N. Y.,

for an 8000-hp steam turbine, direct connected to a 5000-kw generator, to be installed in the Mill Street station in Indianapolis.

PENDLETON, IND.—The Pendleton Telephone Company has increased its capital stock from $10,000 to $20,000. E. D. Allen is secretary.

SOUTH BEND, IND.—The Central Union Telephone Company has ordered plans for the construction of a modern exchange building.

VINCENNES, IND.—The Vincennes, West Baden & Louisville Traction Company has been voted a subsidy of nearly $50,000 by the Township of Vincennes. The company proposes to construct an electric railway from Vincennes to Jasper via Petersburg. A. M. Yelton, of Vincennes, is secretary.

SIOUX CITY, IA.—Preliminary surveys have been taken for the construction of an electric interurban railway between Sioux City and Hartington, Neb. C. T. Johnson, of Martinsburg, Neb.; Messrs. Burgel and Morten, of Hartington, Neb., and James F. Toy, of Sioux City, Ia., and others are interested in the project.

VILLISCA, IA.—The Villisca Light, Power & Fuel Company has awarded a contract to the Condon Construction Company, of Chicago, Ill., for a general overhauling of its power station and distribution system. An additional steam engine will be installed to take care of the day load, and the distribution system will be made one frequency instead of two as at present.

ANTHONY, KAN.—The City Council is reported to be making arrangements to establish a municipal electric light plant, the cost of which is estimated at $10,000.

DELPHOS, KAN.—It is reported that estimates are being prepared for a municipal electric light plant and water works system to cost $30,000.

MARION, KAN.—Plans are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., for a new municipal electric light plant and water works system at Marion, the cost of which is estimated at $60,000.

LEXINGTON, KY.—The Kentucky Water, Heating & Illuminating Company has sold its franchise permitting it to erect transmission lines in Lexington for the distribution of electricity, which it purchased from the city last fall at a cost of $6,100, to the Midland Electric Company. It is said that the new company will erect a plant at once. Pendleton Beckley, of Louisville, Ky., is president of the Midland Electric Company.

PARTRIDGE, KY.—The Upper Cumberland River Telephone Company contemplates the erection of telephone lines from Partridge to Harlan via Poor Fork, a distance of 30 miles. T. J. Smith, of Partridge, is manager.

ST. FRANCISVILLE, LA.—Improvements are being made to the municipal electric light plant, and the electric light system is being extended through the town.

ELLSWORTH, MAINE.—A bill has been introduced in the State Legislature, authorizing the Bar Harbor & Union River Power Company to acquire the property and franchises of the Ellsworth Power Supply Company.

MADISON, MAINE.—The question of installing a new water wheel and dynamo for the municipal electric light plant is under consideration; also the placing of more arc lamps on the streets.

MONTICELLO, MAINE.—A company has been organized in Monticello to take electricity from the Maine & New Brunswick Electric Power Company. It is said that supplies and equipment have been purchased for the plant.

BALTIMORE, MD.—The Maryland Telephone Company has abandoned its suburban service, but will continue to use its long-distance station when its lines are rebuilt. The abandoned exchanges include Towson, Catonsville, Ruxton and Roland Park. The primary cause of abandoning the service was the blizzard of March 4, which practically demolished all the suburban lines of the company. C. E. Bryan is general manager.

MT. WASHINGTON, MD.—The County Commissioners have decided to authorize the Mount Washington Electric Light & Power Company to install 40 electric lamps along the county roads between the villages of Cockeysville and Texas. The company will extend its transmission line from Lutherville to Cockeysville and Texas and will furnish electricity for lamps to the residents along the roads. The service will be ready by May 15.

BONDSVILLE, MASS.—The Boston Duck Company has applied to the State Legislature for permission to supply electricity to its tenement houses and also to the street railway when occasion requires extra power.

CLINTON, MASS.—The Board of Selectmen has awarded the contract for street lighting to the Clinton Gas Light Company for a term of four years, under which the company agrees to furnish incandescent street lamps of 25 cp at the rate of 8 cents per lamp per night and arc lamps of 1200 cp at 33 cents each per night. The company also agrees to replace the present incandescent lamps with 40-cp tungsten lamps. In consideration of a four years' contract the company is to give a discount of 5 per cent on all bills and also a discount of 5 per cent on last year's bills, which amounts to about $650. The present cost of street lighting is $13,000 per year.

LYNN, MASS.—The directors of the Lynn Gas & Electric Company have made a voluntary reduction in the price of gas from 85 cents to 80 cents per 1000 cu. ft., to take effect July 1, 1909.

WAKEFIELD, MASS.—At a recent town meeting the citizens voted to continue to operate the municipal electric light plant and not to purchase electricity from out of town, as recommended by the original committee appointed to investigate the matter. A second committee was appointed, which reversed the report of the first committee, and the later report was accepted.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company is contemplating the installation of a steam auxiliary plant. It is said that the plant will be built as an addition to the present power house on the west side, but will be large enough to contain equipment capable of generating from 25,000 to 30,000 hp.

LANSING, MICH.—Orders have been placed by the Northern Construction Company for rails and general equipment to be used in the construction of the proposed Lansing-Jackson interurban railway south of Mason to Jackson. J. M. Bramlette, superintendent of construction, has established headquarters at Rives Junction, Mich.

LANSING, MICH.—Arrangements have been made by the Michigan Power Company for the organization of an auxiliary company whereby the company will furnish electricity for lamps and motors in Charlotte, Bellevue and surrounding country. The Michigan Power Company recently secured a 30-year franchise and also a 10-year contract for street lighting in the city of Charlotte. The company has also made similar arrangements in Bellevue.

MARQUETTE, MICH.—The annual report submitted by the light and power commission shows a net profit of $36,288 for the municipal electric light and power plant for the year ending March 9, 1909, which is an increase of $7,000 over the net earnings of any previous year. In addition to this the commission has paid off $5,000 of its outstanding bonds and has expended $34,139 for new equipment during the year. The plant now represents an investment of $233,101, of which $137,601 has been paid out of the earnings of the plant.

SAULT STE. MARIE, MICH.—The Sault Ste. Marie Gas & Electric Company has recently been reorganized, and it is said the company contemplates an expenditure of about $25,000 in improvements this year.

TUSTIN, MICH.—The capital stock of the Lake & Oscola Telephone Company has been increased from $450 to $2,000.

CANBY, MINN.—The Farmers' Mutual Telephone Company, of Gary, S. D., has applied for a franchise to enter the city.

DULUTH, MINN.—The Duluth Telephone Company is making preparations to place its wires underground.

LONG PRAIRIE, MINN.—George Lapo and others are interested in a project for the construction of a telephone line, 11 miles long, to the Dinkel-Dreher neighborhood.

ST. PAUL, MINN.—The question of extending the transmission lines of the municipal electric light plant to Kasota is under consideration.

WELLS, MINN.—The managers of the municipal electric light plant are said to be considering the question of establishing a 24-hour service.

HATTIESBURG, MISS.—The Southern Lumber & Ice Company, it is reported, is making plans to install an electric light and power plant.

BOZEMAN, MONT.—The contract for construction of the interurban electric railway from Bozeman to Salesville, 20 miles in length, has been awarded to the Westinghouse, Church, Kerr & Company, of New York, N. Y. Later the railway will be extended from Salesville to Three Forks, a distance of 35 miles.

BUTTE, MONT.—A 50-year traffic agreement has been entered into by the Montana Independent Telephone Company, of Butte, and the Interstate Telephone Company, of Spokane, Wash., whcih will give residents of Butte and of western Montana telephone communcation with Spokane and other towns in the Inland Empire. A through copper circuit from Butte to Spokane and a new telephone line from Mullan, Idaho, to Missoula, Mont., will be built at once.

ROUNDUP, MONT.—The question of installing an electric light plant in Roundup is under consideration.

WHITEFISH, MONT.—It is reported that the Flathead Valley Water Power Company is making arrangements to construct a substation in Whitefish.

JOPLIN, MO.—The Board of Public Works has placed a contract with the United Iron Works Company, Joplin, Mo., for a 500-hp boiler to be installed in the municipal electric light plant.

UNIVERSITY (P. O., ST. LOUIS), MO.—The proposition of issuing $20,000 in bonds for the construction of an electric light plant will be submitted to the vote of the people.

BROKEN BOW, NEB.—At the coming election the citizens will vote on the proposition to grant a franchise for an electric light plant. The city will reserve the privilege to purchase the plant in 10 years.

PLAINVIEW, NEB.—H. J. Nelson, city clerk, would like to correspond with parties with the view of establishing an electric light plant in Plainview.

WAHOO, NEB.—The new municipal electric light plant system is completed and placed in operation. The lamps for the street lighting system have not been installed, but will be erected soon. The price of electricity for lamps has been reduced from 8 to 5 cents per kw-hour.

RENO, NEV.—A bill has been introduced in the Nevada Assembly which provides for the granting of a franchise to the Nevada Telephone-Telegraph Company for a telephone and telegraph line from Reno to

Ely, via Carson City, Dayton, Fort Churchill, Goldfield and Tonopah. The company has offices in Goldfield, Elv, Tonopah and Carson City, and as soon as this franchise is secured will begin building its line into Reno.

TONOPAH, NEV.—Plans are being considered by the Western Smelters Corporation for the construction of a large smelter on the Carson River, near Brunswick, Nev., work on which will begin in June. The plant will be operated by water power.

CLOVIS, N. M.—Plans are being prepared by Burns & McDonnell, consulting engineers, Kansas City, Mo., for an electric light plant, water works and sewer systems in Clovis, for which bonds to the amount of $125,000 have been voted.

NAMBE, N. M.—E. H. Fisher, of Cimarron, N. M., writes that he contemplates developing the water power of the Pecos and Nambe Rivers, and will erect two power plants with a total output of 5000 hp. The cost of the work is estimated at about $500,000.

SANTA FE, N. M.—A telephone company has been organized at Stanley to construct a telephone line from Stanley to this city. The company is capitalized at $6,000.

ALBANY, N. Y.—The proposed bill appropriating $450,000 for the purchase of a site, construction and equipment of power house to furnish light and heat for the Capitol and new State Educational Building, and for construction of conduits to connect the buildings, has been approved by the State Trustees of Public Buildings. The Trustees also decided to recommend to the Legislature an appropriation of an additional $1,000,000 for carrying on the work of constructing the State Educational Building. The cost of the building complete is estimated at $4,000,000.

BUFFALO, N. Y.—Governor Hughes has signed the bill permitting the city to issue bonds to pay for its share of installing an electric light plant in the city hall. The cost of the plant is estimated at $75,000, to be divided between the city and the county. The county has already provided its share. It is expected to have the plant installed within six months.

CLIFTON SPRINGS, N. Y.—At an election held March 16 the citizens voted against the proposition to issue $8,000 in bonds, the proceeds to be used for enlarging and improving the municipal electric light plant.

GASPORT, N. Y.—The business men of this village are considering the question of lighting Main Street with electricity.

HERKIMER, N. Y.—The plant and holdings of the Herkimer County Telephone Company was sold at referee's sale March 24 to C. H. Poole, of Utica, N. Y., representing independent telephone interests, for $16,000.

NEW YORK, N. Y.—The Board of Estimate has appropriated $102,000 for the installation of an electric light plant in the New York Public Library.

NICHOLVILLE, N. Y.—The electric light plant of the Nicholville Electric Lighting Company was destroyed by fire March 16, causing a loss of about $10,000. The plant was built about a year ago and was located on the east branch of the St. Regis River. The company supplied electricity in the villages of Nicholville, Fort Jackson, Hopkinton, Moira and North Lawrence, and was making arrangements to extend the transmission lines to Brushton. The company has announced that it will rebuild the plant at once and hopes to have the system in operation again within four months. The streets of the villages will remain in darkness until the plant is completed.

RAYBROOK, N. Y.—The State Tuberculosis Hospital has petitioned the Legislature for an appropriation for additional conduit work, the cost of which is estimated at $9,100.

ROCHESTER, N. Y.—Plans have been prepared for a new electric railway, to be known as "the Scenic Route," which will extend from Rochester to Batavia, thence to Mumford, Leroy, Scottsville, Silver Lake, Portage Park and other towns and villages that have no electric railway connections with Rochester. D. C. Salyerds, of Scottsville, is principal promoter of the enterprise.

ROCHESTER, N. Y.—Plans and specifications are being prepared by C. C. Peck, consulting engineer, E. & B. Building, Rochester, N. Y., for an electric power plant to be installed in the new building to be erected by W. N. Clark & Company, who are now ready to receive proposals on the following machinery: Two 125-hp horizontal tubular boilers, one 50-kw or 75-kw generator direct connected to auto high-speed engine, and one 15-ton steam engine-driven ice machine.

SYRACUSE, N. Y.—Contracts have been placed for the extension of the Rochester, Syracuse & Eastern Railroad Company from Port Byran to Syracuse.

UTICA, N. Y.—The supervisors' committee on installing an electric light plant to furnish electricity for lighting the county buildings has engaged Horace B. Sweet as consulting engineer to make an estimate of the cost of installing and operating the plant.

BURLINGTON, N. C.—The Board of Aldermen has granted the Southern Power & Traction Company a franchise to supply electricity for motors to concerns using 24 hp or more. The restriction of 24 hp was made on account of arrangements having been made to equip the municipal electric light plant to furnish a day service for power. The Southern Power & Traction Company is planning to build a large dam across the Haw River, where it is proposed to develop 14,000 hp. The company has secured franchises in Burlington, Graham, Reidsville, Wentsworth and other towns to furnish electricity.

CANTON, N. C.—G. N. Henson, cashier Bank of Canton, and D. J. Kerr, electrical engineer of the Champion Fiber Company, are considering the question of erecting an electric light plant.

CHARLOTTE, N. C.—The Southern Power Company expects to have its new plant at Rocky Creek, on the Catawba River, in South Carolina, completed by April 1. This plant will be the third hydro-electric development in operation, and the company is now pushing work on the fourth and one of the largest developments under its control at Ninety-Nine Islands, on Broad River, near Gaffney, S. C. Much of the work at this plant is done by electrical power transmitted from plants of the company at a distance of 50 miles or more.

DUNN, N. C.—The City Council contemplates the purchase of machinery for the municipal electric light plant as follows: One 100-hp engine at 125 lb. pressure, 250 to 300 r.p.m.; two 100-hp boilers, return tubular, 125 lb. pressure; one 75 to 90-kw single-phase 60-cycle 2300-volt generator, complete with exciter. Offers of second machinery in good condition will be considered. H. B. Charles is superintendent of municipal electric light plant.

DURHAM, N. C.—The Erwin Cotton Mills Company has selected a site in West Durham for its proposed new mill, with power plant and warehouses. The mill will be operated by electricity, which will require about 2000 hp to drive the machinery. The cost of the plant is estimated at about $2,000,000. Plans and specifications are being prepared by F. P. Sheldon & Sons, engineers, of Providence, R. I.

GREENSBORO, N. C.—The North Carolina Public Service Company, capitalized at $3,500,000, has taken over the property of the Greensboro Electric Company. The Southern Power Company will furnish the Public Service Company with electricity. The officers of the new company are: L. H. Hole, Sr., president; Bird S. Coler, vice-president; L. H. Hole, Jr., secretary and treasurer, all of New York, N. Y., and Z. V. Taylor, of Greensboro, general counsel.

NEWBERN, N. C.—Bids will be received by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until April 23 for the installation of a conduit and wiring system and extension of the present gas-piping system in the U. S. post office, court house and custom house at Newbern, N. C.

RALEIGH, N. C.—A series of demonstrations of cooking by electricity have been given here by the General Electric Company in behalf of the Carolina Power & Light Company, of Raleigh. The Woman's Club of Raleigh is interested in the movement, which is attracting general attention.

SALISBURY, N. C.—The Southern Power Company is making arrangements to extend its transmission lines to Salisbury and Vance Cotton Mills, which will be completed in a short time. The motive power of the Vance Mills will be changed from steam to electricity. The Southern Power Company is erecting a steel tower line to Salisbury, by the way of Albemarle, which is expected to be completed about June 1, when electricity for use in Salisbury will be transmitted by the new route.

WILMINGTON, N. C.—The Tidewater Power Company contemplates improvements to its properties at Wilmington and Wrightsville Beach, which will include the installation of an engine and additional generating equipment at the Wilmington plant.

FARGO, N. D.—The Otter Tail Power Company, of Fergus Falls, Minn., has submitted a proposition to the City Council offering to supply the city with electricity for street and commercial lighting and operating the water works plant at the rate of 2½ cents per kw-hour. Paul Doty, president of the Union Light, Heat & Power Company, also offered to furnish the city all the electricity it required at the switchboard at the same price as the Otter Tail Power Company offered, and to sell the city its street lighting equipment. It is not expected that any action will be taken for some months.

GRAND FORKS, N. D.—The Board of Regents of the University of North Dakota will soon let contracts for the construction of a new power house, plans for which have been prepared.

CANAL DOVER, OHIO.—Struthers-Wells Company, of Warren, Pa., has been awarded the contract for the construction of the municipal electric light plant for $34,700.

CANTON, OHIO.—Plans have been prepared by the Stark County Telephone Company for extensions and improvements to its system in Canton and Alliance, which will involve an expenditure of about $32,000.

CLAYTON, OHIO.—The School Board has decided to install a power plant at the new manual training high school to be used by the students in electrical engineering. R. L. Peterson has been engaged as consulting engineer in connection with the work.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has filed notice with the Secretary of State of an increase in capital stock from $5,000,000 to $6,500,000. Samuel Scovil is president, and S. C. D. Johns, secretary.

CLEVELAND, OHIO.—Judge Taylor, of the Federal Court, has authorized the receivers of the Cleveland street railway system to expend $42,250 for new boilers. Six 300-hp boilers in the Viaduct station will be replaced with the same number of units of double the capacity. The court denied receivers permission to spend $600,000 in relaying 23 miles of track, but instructed them to make temporary repairs.

FOSTORIA, OHIO.—The Citizens' Telephone Company has petitioned the City Council for a franchise to construct an underground conduit system in this city.

PARIS, OHIO.—The capital stock of the Farmers & Merchants' Telephone Company has been increased from $12,000 to $21,000.

WEST LIBERTY, OHIO.—The City Council is considering the question of purchasing the local electric light plant, to be operated by the municipality. The committee has been appointed to investigate municipal ownership plants in other cities, and report to the Council.

WEST TOLEDO, OHIO.—The Town Trustees have entered into a contract with the Toledo Railways & Light Company for street lighting for a period of five years. Under the terms of the contract the company is to furnish 34 arc lamps at the rate of $60 per lamp per year. The lamps are to be installed within 60 days.

ANADARKO, OKLA.—Work has commenced on the construction of the hydro-electric plant and dam across the Washita River, which will include the construction of a reinforced concrete dam, with spillway 132 ft. wide, and power house 33 x 37 ft., according to plans of the Amursen Hydraulic Construction Company, of Boston, Mass. The equipment will include two 100-kw generators direct connected to turbines, to be operated under a 14-ft. head of water; also a turbine-driven pump to supply water to the city. The cost of the work is estimated at about $80,000. The O'Neil Engineering Company, of Dallas, Tex., has charge of construction of the plant.

BLACKWELL, OKLA.—Plans are being prepared by Burns & McDonnell, consulting engineers, Scarritt Building, Kansas City, Mo., for the construction of an electric light plant and water works system in Blackwell to cost about $40,000.

CAPITOL HILL, OKLA.—The Council has granted a franchise to the Oklahoma Gas-Electric Company to furnish electricity in the town, subject to a vote of the people.

HYDRO, OKLA.—Burns & McDonnell, consulting engineers, Scarritt Building, Kansas City, Mo., are preparing plans for an electric light plant and water works system at Hydro to cost about $25,000.

KIOWA, OKLA.—At a recent election the citizens voted to issue $31,000 electric light and water works bonds.

LEHIGH, OKLA.—The citizens have voted to issue $12,500 in bonds, the proceeds to be used for the construction of an electric light plant. The O'Neil Engineering Company, of Dallas, Tex., will have charge of the construction of the plant.

OKEMAH, OKLA.—The city has voted to issue $55,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

SENTINEL, OKLA.—We are advised that the Town of Sentinel has not yet awarded a franchise for an electric light plant, as reported in the issue of March 18, but contemplates an issue of bonds for construction of a municipal plant, on which a vote will soon be taken.

WALTER, OKLA.—The citizens have voted to grant the O'Neil Electrical Company, of Dallas, Tex., a 20-year franchise to furnish electricity in this city. The company proposes to develop the water power of Cache Creek, and will furnish electricity for lighting and manufacturing purposes.

WATONGA, OKLA.—Arrangements are being made to install a new engine and generator in the municipal electric light plant, at a cost of about $3,500. J. C. Stanfield is clerk.

JOSEPH, ORE.—The Wallowa Lake Light & Power Company, recently organized, proposes to furnish electricity for lamps and motors in Joseph and other cities.

JOSEPH, ORE.—The Joseph Electric Light & Power Company is making extension and improvements to its plant, and has applied to the City Council for a new franchise in this city.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until April 19 for furnishing supplies during the fiscal year ending June 30, 1910, as follows: Wire cable, wire, boiler tubing, steel, brass, copper, etc., as per circular (No. 499). Bids will also be received at the same place until April 21 for furnishing the following supplies: Centrifugal pumps, copper, wire cable, steel and brass tubing, etc., as per circular (No. 500). Blanks and general information relating to these circulars may be obtained at the above office and at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing agent.

HAZLETON, PA.—The Hardwood Light & Power Company, which is now erecting a large power plant in Harwood, has secured contracts to furnish electricity to operate all the street car lines between Berwick and Danville, and also for operating all the electric lighting plants in the same section.

KECKSBURG (P. O. MT. PLEASANT), PA.—J. M. Keck, owner of the Kecksburg Mineral Springs, contemplates building a large addition to his bottling establishment and will install an electric lighting plant.

PHILADELPHIA, PA.—The Construction Company General, 547 Drexel Building, Philadelphia, Pa., would like to correspond with manufacturers of electrical equipments, arc and incandescent lamps, copper wire, concrete mixers, steam engines, natural gas engines, boilers, etc. The company was recently organized to do a general contracting business for the purpose of constructing electric light plants, water works and sewer systems, and other public improvements. Harry A. Locke, of Philadelphia, Pa., is president of the company.

READING, PA.—Mayor Rick has signed the ordinance granting the Reading Electric Light & Power Company and the Metropolitan Electric Company, lessee, permission to construct and maintain underground conduits from the western boundary line of the city and on certain streets in the city to connect with the plant of the Reading Electric Light & Power Company, which is leased to the Metropolitan Electric Company.

SEWICKLEY, PA.—The Borough Council has accepted the plans for the construction of a municipal electric light plant, for which a bond issue of $30,000 was authorized over a year ago, but owing to the financial depression the bonds were not sold.

STEELTON, PA.—The Steelton Light, Heat & Power Company has decided to enlarge and increase the output of its plant, which will include the installation of steam engines direct connected to alternating-current, three-phase generators. It is said that the company does not intend to dispense with the electrical service from the York Haven Power Company's hydro-electric plant on the Susquehanna River, at York Haven, but will rely upon it in times of extraordinary demand or emergency.

TOPTON, PA.—It is stated that the Inter-County Electric Company will soon award contracts for its proposed electric railway between Lyons and Allentown, a distance of 21 miles. The power station will be located at Alburtis. The company also proposes to furnish electricity for lamps and motors. Maxwell H. Bochow, of Topton, is president and general manager.

UPPER DARBY, PA.—The Upper Darby Township Commissioners are considering the question of extending the street lighting system to Addingham, Oakview, Garrettford, Fernwood, East Lansdowne, Primos, Cardington and Milbourne.

WELLSVILLE, PA.—C. C. Spahr, of York, Pa., has purchased the old flouring mill on Conewago Creek, three miles from Wellsville, where he proposes to install a hydro-electric power plant for the purpose of furnishing electricity for lamps and motors in Wellsville and to the farmers in this vicinity. Mr. Spahr also plans to extend the transmission line to Dover, seven miles distant. The plant will have an output of from 150 to 200 hp and will cost approximately $25,000.

PASCOAG, R. I.—H. B. Rust & Company, of Providence, R. I., have submitted a proposition to town officials offering to take over the electric plant of the Pascoag fire district and to operate it for a term of 15 or 20 years, and to enter into a contract with the town to furnish street lamps for $4,000 per year, and at the end of the time to turn the plant over to its present owners in good condition. The company states that it will require an expenditure of about $15,000 to put the plant in good order. The district voters decided to appoint a committee to investigate the matter and report at a later meeting.

LEXINGTON, S. C.—The citizens are considering the question of establishing a municipal electric light plant and water works system in Lexington.

OLDHAM, S. D.—The question of establishing an electric light plant in Oldham is under consideration.

MORRISTOWN, TENN.—Arrangements are being made to improve and increase the output of the municipal electric light plant, which will involve an expenditure of about $25,000. Contracts have already been placed for machinery and equipment.

ROCKWOOD, TENN.—The city is considering a bond issue of $20,000, the proceeds to be used for improvements to the municipal electric light plant, street work and other public work.

BRYAN, TEX.—The citizens on March 2 voted to issue $75,000 in bonds, the proceeds to be used for the construction of an electric light plant, water works and sewer system. As yet no engineer has been employed. J. T. Maloney is Mayor.

OLNEY, TEX.—Daugherty Brothers, of Alpine, Tex., are reported to be interested in the construction of an electric light plant and ice factory in Olney.

OLNEY, TEX.—T. H. Kemp is reported to be interested in a project to establish an electric light plant in Olney.

PORT ARTHUR, TEX.—Arrangements are being made by the South Texas Telephone Company to enlarge and improve its system in Port Arthur.

SAN ANTONIO, TEX.—The San Antonio Gas & Electric Company contemplates the construction of a new power plant, to cost about $125,000.

PROVO, UTAH.—Two estimates for the construction of electric power plants have been submitted by Mayor Decker to the City Council, both prepared by L. L. Nunn, of the Telluride Power Company. One plan is for a plant to be located at the north fork in Provo Canyon, with an output of 1600 hp, to cost $102,000; the other to be located at the mouth of the canyon, at a cost of $117,000, with an output of 1400 hp.

SALT LAKE CITY, UTAH.—A bill has been introduced in the State Legislature asking for an appropriation for the Agriculture College of Utah, the proceeds to be used for the installation of an electric power plant to furnish electricity for lamps and motors for the several departments of the college and for lighting the grounds.

WALLINGFORD, VT.—The Rutland Railway, Light & Power Company has commenced work on the construction of its substation in Wallingford. The equipment of the station will include two 75-kw transformers, to change the voltage from 6600 to 2300 volts, with a 50-light transformer for street lighting service, and a three-panel switchboard. The cost of the building with equipment is estimated at $3,000.

RICHMOND, VA.—Special commissioners in the case of the Virginia Passenger & Power Company are instructed in a decree of the United States Circuit Court to proceed with the sale of the property named after advertising four weeks. The court has ordered the sale of the properties, in which Frank J. Gould is large interested. Bondholders who objected to the sale have filed a petition with the Supreme Court to take the case.

ORIENT, WASH.—C. H. Patten, A. R. Luncheford and associates, of Spokane, Wash., it is said, will soon commence work on the construction of a dam and power plant on Boulder Creek, near where it empties into Kettle River, where it is claimed that 2500 hp can be developed with a normal flow of water. The cost of the dam and power plant is estimated at $200,000. The plant will furnish electricity to Orient and towns and mines in this vicinity.

PORT TOWNSEND, WASH.—It is reported that surveys are being made for an electric railway from Hadlock to Port Townsend, covering the old Northern Pacific franchise.

PORT TOWNSEND, WASH.—The County Commissioners have granted a franchise to C. D. Chapman, of Seattle, Wash., to erect transmission lines for the distribution of electricity to Bremerton and Port Townsend from the Dosewallip River. Mr. Chapman is said to have secured a contract from the Navy Department to furnish electricity to the Bremerton Navy Yard.

PROSSER, WASH.—C. E. Forsyth, of White Bluffs, has secured a 50-year franchise for the White Bluffs & Columbia River Telephone Company.

SEATTLE, WASH.—Bids will be received at the office of James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until April 19 for the installation of an electric wiring system for the U. S. Government buildings at the Alaska-Yukon Pacific Exposition at Seattle.

SPOKANE, WASH.—It is reported that the Northern Idaho & Montana Electric Light Company contemplates the construction of a large hydro-electric power plant at Cabinet Gorge, on Clark Fork River, where it is said that 75,000 hp can be developed, at a cost of about $2,000,000. The company was recently incorporated and has taken over several electric light and water plants in the northern part of Idaho and Montana, including the plant of the Pend Oreille Electric Light Company, of Sandpoint, Idaho; the Newport Light & Power Company, of Newport, Wash.; the Flathead Valley Water Power Company, of Kalispell, Mont., and others. The company proposes to furnish electricity for lamps and motors in every town in the northern part of Idaho and Montana, and will also furnish water to the different cities through the local plants acquired.

SPOKANE, WASH.—The Inland Empire Portland Cement Company, recently incorporated, will soon commence work on the construction of a large plant, which will involve an expenditure of about $1,000,000. The company has purchased the mineral holdings of Lewis P. Larson, of Spokane, located near the mouth of Sullivan Creek, and also his water rights on that stream. Water rights have also been filed on Sullivan Lake, which will be raised to increase its storage capacity. It is estimated that from 8000 to 12,000 hp can be developed under a head of 465 ft. The cement mill will be operated by water power, which will require 2000 hp, and the rest of the power will be utilized to generate electricity for use of the company and for commercial purposes. F. A. Blackwell, president of the Idaho & Washington Northern Railroad Company, is interested in the company.

CLARKSBURG, W. VA.—The Fairmont & Clarksburg Traction Company is securing rights of way for its proposed extension from Grasselli and Bridgeport, a distance of three miles, to be made this coming summer.

WHEELING, W. VA.—Albert M. Schenk states that he has closed a deal with Pittsburgh capitalists to build a high-speed electric railway connecting Wheeling with Pittsburgh. It is said that the Wabash tracks will be used. The railway will cost $1,500,000, and it is expected to have the road in operation by the spring of 1910.

BARABOO, WIS.—The City Council is considering the question of establishing a municipal electric light plant.

PRESCOTT, WIS.—The Prescott Light & Power Company is said to be making arrangements to erect an office building and substation on Orange Street.

SPARTA, WIS.—The directors of the Sparta-Melrose Railroad Company have closed a deal with the Western Transportation Company, of St. Paul, Minn., which will insure the immediate construction of the railway from Sparta to Melrose, 26 miles distant. The railway will run by the way of the new Government reservation and will be equipped with either electric or gasoline motors.

CHEYENNE, WYO.—Bids will be received by Captain V. K. Hart, acting quartermaster, U. S. A., at the office of the constructing quartermaster, Cheyenne, Wyo., until April 24 for furnishing all labor and material required in the construction and remodeling of the electric lighting system at Fort D. A. Russell, Wyoming, as follows: (1) Constructing primary, secondary service transmission and street lamp lines; furnishing and installing cut-outs and street lamp brackets and installing transformers; removing part and remodeling part of old line. (2) Furnishing and installing tungsten lamps, switchboard and all apparatus for substation. (3) Furnishing all watt meters and transformers. (4) Installing interior conduit wiring and arc lamps for lighting cavalry drill hall. (5) Construction of buildings for transformer substation, in accordance with plans and specifications which are on file at the above office and in the offices of the Chief Quartermaster, Department of Missouri, Omaha, Neb.; Chief Quartermaster, Department of Colorado, Denver, Col.; Chief Quartermaster, Department of the Lakes, Chicago, Ill.; Depot Quartermaster, St. Louis, Mo., and Quartermaster, Fort Leavenworth, Kan.

CALGARY, ALB., CAN.—It is reported that the Calgary Power & Transmission Company will commence work immediately on its proposed power development at Horseshoe Falls, which will involve an expenditure of more than $1,000,000.

CRANBROOK, B. C., CAN.—The Board of Trade has petitioned the Provincial Government to build a telephone line through the Kootenay country.

CRESTON, B. C., CAN.—The Goat River Power Company has secured permission for the construction of a 10-mile tramway to Duck Creek.

DUNCANS STATION, B. C., CAN.—The Portland Canal Mining Company is making arrangements for the installation of a power plant, aerial tram and concentrator at an approximate cost of $75,000. C. H. Dickie is president of the company.

FERNIE, B. C., CAN.—The Cranbrook Telephone Company, of Cranbrook, B. C., has decided to build a telephone line between Fernie, B. C., and Lethbridge, Alta.

NELSON, B. C., CAN.—The Allis-Chalmers-Bullock Company, of Montreal, Que., has received the contract for the installation of the second unit of the civic power plant for $74,900.

BRANDON, MAN., CAN.—The City Council has applied to the Municipality of Winnipeg for service from its civic power plant at Point du Bois, which is about 200 miles from this city.

TORONTO, ONT., CAN.—Bids will be received until April 30 by Mayor Joseph Oliver, chairman Board of Control, City Hall, Toronto, Ont., for underground cable. Specifications can be seen and forms of tender obtained at the Electrical Department, City Hall, Toronto.

IBERVILLE, QUE., CAN.—The Town Council has awarded a contract to the Northern Electric & Manufacturing Company, Ltd., for installing a Western Electric generator, exciter and switchboard for the municipality.

MONTREAL, QUE., CAN.—The Merchants' Light & Power Company has applied to the Dominion Legislature for a charter to supply electricity and gas within a specified territory in Montreal for lamps and motors. The company is to be capitalized at $1,500,000 with power to increase it to $3,000,000. The petitioners for incorporation are: Odilion Lemire, J. B. Letendre, B. Mercier, A. T. Vallieres, O. Lecompte, L. J. Tarte, J. Durand, R. A. Brossard and others.

ALAMEDA, SASK., CAN.—The organization of the Alameda Rural Telephone Company has been completed, and plans call for the immediate construction of 68½ miles of rural telephone lines for 60 subscribers.

BELLE PLAINE, SASK., CAN.—Sealed tenders will be received by John Poyser until April 15 for the construction and supply of all material for the proposed telephone line of the Stoney Beach Rural Telephone Company.

GOVAN, SASK., CAN.—The organization of the Govan Rural Telephone Company has been completed, and tenders for the construction of a telephone system will be called for soon.

GREY, SASK., CAN.—Sealed tenders will be received by Elmer Auld, Grey, Sask., until April 3 for the construction of 24 miles of telephone pole line, 30 poles to the mile, and 72 miles of wire for the Grey-Milestone Telephone Company.

MELVILLE, SASK., CAN.—The Council is considering plans for a local telephone system. For further information address Leon Benoit, secretary.

NORTH BATTLEFORD, SASK., CAN.—Several syndicates have applied to the City Council for franchises to supply electricity for lamps and motors in this city. No decision has yet been made by the Council.

WILCOX, SASK., CAN.—Sealed tenders will be received by A. E. Hadley until April 5 for all work and materials necessary for the construction of a telephone system for the Wilcox Rural Telephone Company.

New Incorporations.

ROGERS, ARK.—The Rogers & Pea Ridge Interurban Railway Company has been organized and will soon apply for a charter to construct an interurban railway between Rogers and Pea Ridge. The officers of the company are: A. P. Potter, president; J. F. Walker, vice-president, Bryan Snyder, secretary, and J. J. Putnam, treasurer.

PLACERVILLE, CAL.—The Heddens Mining & Electric Company has been incorporated, with a capital stock of $1,000,000, for the purpose of operating mines and erecting electric power plants. The directors are: H. Meehan, of Placerville, Cal.; Ralph D. Heddens, of San Diego, Cal., and Daniel R. R. Caldwell, of Sacramento, Cal.

SAN FRANCISCO, CAL.—The Dunfee Electric Company, capitalized at $10,000, has been incorporated by C. H. Dunfee, F. Finch, A. J. Shaw, E. W. Shaw and Alice M. Dunfee.

SAN FRANCISCO, CAL.—The Sacramento Valley Power Company has been incorporated, with a capital stock of $800,000, by P. C. Morf, H. C. McPike, L. Q. Havan, J. J. Dailey, J. F. McCue, F. W. Nightingill and E. A. Potter.

SAN FRANCISCO, CAL.—The Equitable Light & Power Company has been incorporated, with a capital stock of $750,000. The company is installing electric plants in the Phelan Building and the Whitney Building and will be ready to supply electricity and hot water in the near future in that locality. It is said the company contemplates the construction of another plant outside the city. The directors are: F. G. Cartwright, A. E. Long, Leo Meyberg, M. S. Wilson, M. D. Levenson, C. N. Beal, of San Francisco, and James Fisher, of Berkeley, Cal.

SAN FRANCISCO, CAL.—The California Electric Generating Company has been organized as a subsidiary corporation of the Great Western Power Company for the purpose of constructing and operating an electric steam generating plant in Oakland. This plant will be leased to the Great Western Power Company and will be operated in connection with the Great Western power plant, located on the Feather River. The company is capitalized at $7,500,000 and $5,000,000 in bonds have been authorized. The construction of the power house is well under way, and steam turbine generator units with a rating of 13,500 hp will be installed at first. The power house is so arranged that additions can be made to the plant as needed.

RIFLE, COL.—The Cache & Beaver Telephone Company has been incorporated with a capital stock of $20,000 by Otto Hahnwald, Lloyd Shultz and J. B. Elrod, of Rifle, Col.

GRIFFIN, GA.—The Middle Georgia Interurban Railway Company has been incorporated, with a capital stock of $200,000, by Charles F. Howe, of Milledgeville; L. W. Roberts, of Atlanta, Ga., and W. F. Smith, of Flovilla, Ga. The company proposes to construct an electric railway, 70 miles in length, connecting Griffin and Social Circle, with branches to Flovilla and Monticello.

DANVILLE, ILL.—The Paris-Northern Railway Company has been incorporated with a capital stock of $5,000 to construct an electric railway from Ridgefarm to Paris, for which surveys have been completed. The capital stock of the company is $5,000 and the directors are: W. M. Bridgett, R. C. Parks, L. C. McGee, George G. Roland and Charles Troup.

FLAGG CENTER, ILL.—The Flagg Center Telephone Company has been incorporated with a capital stock of $35,000 by John Gibson, A. B. Eyster, John T. Lansden and Robert Gibson.

PERU, ILL.—The Cedar Point Telephone Company has been chartered with a capital stock of $11,000 by Elmore H. Whittaker, Robert H. Johnston and John Martens.

TINLEY PARK, ILL.—Articles of incorporation have been filed for the Tinley Park Electric Light Company, with a capital stock of $2,500, by E. B. Quackenbush, Frances Youker and Albert J. Kelly. The company proposes to construct and operate an electric light and heating plant.

CROSS PLAINS, IND.—The Farmers' Mutual Telephone Company has been organized, with a capital stock of $890. Daniel Denmore is president of the company, and Martin Vanosdan, secretary and treasurer.

FLORA, IND.—The LeBaw Electric Company has been incorporated to build and equip an electric light plant in this city. William B. Alonzo, of Reuben; Darwin and I. M. LeBaw are directors.

HARRISON, IND.—The Flat-Wood Independent Telephone Company has been incorporated with a capital stock of $500 by O. P. Martin,

INDIANAPOLIS, IND.—The directors of the Indianapolis Telephone Company will ask for bids immediately for the construction of a branch exchange in the Irvington suburb. The cost of building and new equipment is estimated at $80,000.

INGALS, IND.—The Fall Creek Telephone Company has been incorporated to build and operate a telephone system in the western part of Madison County, with principal exchange in Ingals. Charles Hiday, G. W. Pelligrew and P. T. House are directors.

EDGEWOOD, IA.—The Edgewood Farmers' Telephone Company has been incorporated, with a capital stock of $2,000 and the following officers elected: R. L. Phelps, president; J. A. Stone, vice-president; J. S. Wait, secretary, and U. G. Elliott, treasurer.

IOWA FALLS, IA.—The Iowa Falls & Owaso Telephone Company has been chartered with a capital stock of $2,450 and the following directors: J. M. Rankin, John Robertson, Joseph Brewster and others.

MERIDEN, IA.—The Farmers' Telephone Company has been organized for the purpose of taking over the Liberty-Meriden, West Lines, Mill Creek and Town Mutual telephone lines. The following officers have been elected: J. E. Weise, president; D. Holly, secretary, and Robert Miles, treasurer.

MILES, IA.—The Miles & Bryant Telephone Company has been incorporated with a capital stock of $500 by William Baty, John P. Millhaem and others.

JENNINGS, LA.—Articles of incorporation have been filed for the Lake Arthur, Jennings & Northern Railway Company to construct an electric railway from Lake Arthur through Jennings, to connect with a point on the Colorado, Southern, New Orleans & Pacific Railroad, about 50 miles in length. W. B. Conover, of Jennings, is president.

NEW ORLEANS, LA.—The New Orleans & Seashore Railway Company has been chartered, with a capital stock of $2,000,000, to carry out the plans of the New Orleans & Seashore Air Line Railway. The company proposes to construct an electric railway from Amesville, opposite New Orleans, to Grand Isle, La., a distance of 55 miles. The charter of the company gives it the privilege of extending its railway the full length of Grand Isle, with a branch to Bayou Lafourche and along the bayou from Rockport to the Gulf of Mexico. The incorporators are: James W. Porch, J. H. Menge, J. D. W. Benson, Leo A. Marrero and Lamar C. Quintero, all of New Orleans.

SOLON, MAINE.—The Solon Electric Light Company has filed articles of incorporation, with a capital stock of $10,000. The officers are: C. A. Paul, president, and P. S. Longley, treasurer and clerk, both of Solon.

BOSTON, MASS.—The Public Service Investment Company has organized as a holding company for the Stone & Webster operating companies, of which there are 28, having an outstanding capitalization of over $113,000,000. The company is capitalized at $3,000,000.

BRANCH, MICH.—The Carr Telephone Company has been organized with a capital stock of $575 to build a telephone in Branch. W. L. Ingalls is president.

CRYSTAL, MICH.—The Crystal Telephone Company has been incorporated, with a capital stock of $5,000. The officers of the company are: J. P. Spencer, president; George Ingersoll, vice-president; R. L. Ruedger, secretary; George Felton, treasurer, and J. G. Deyoe, general manager.

TWINING, MICH.—The Twining Mutual Telephone Company has been organized with a capital stock of $5,000 and the following named officers elected: C. J. Shreve, president; G. H. Hollister, vice-president; A. H. Townsend, secretary, and John J. Finerty, treasurer.

WOODSTOCK, MICH.—The North Star Telephone Company has been incorporated, with a capital stock of $120,000.

WYANDOTTE, MICH.—The Detroit River Telephone Company, of Wyandotte, has been incorporated, with a capital stock of $50,000, for the purpose of operating a telephone service in Wyandotte, Ford City, Grosse Isle and Trenton. The incorporators are: F. T. Moran, Arthur E. Barker, James E. Brailey, S. E. Fisher and T. A. E. Weadlock.

KELLOGG, MINN.—The Telephone Company of Kellogg has been organized with a capital stock of $10,000 and the following officers: M. K. Wolfe, of Kellogg, president; Charles Gengnagel, vice-president; L. O. Cooke, secretary and manager, and J. D. Bricher, treasurer. The company has taken over the old Dwelle telephone line from Kellogg to Plainview, which will be connected with the local system.

RED LAKE, MINN.—The Red Lake & Eastern Marshall Telephone Company has been incorporated to construct a rural telephone line from Gryla to Thief River Falls. About 50 miles of wire will be erected.

LEWISTOWN, MONT.—The Husen Creek Telephone Company has filed articles of incorporation with a capital stock of $5,000 for the purpose of constructing and operating a telephone line between Lewistown and the divide between Cottonwood Creek and the east fork at Snowy Mountains in Fergus County.

McLEOD, MONT.—The Main Boulder Telephone Company has been incorporated with a capital stock of $2,000 by G. W. Moore and others.

HUBBARD, NEB.—The Hubbard Telephone Company has been organized and the following named officers elected: D. Hartnett, president; William Reninger, secretary, and William Geortz, treasurer. The company will erect a telephone line 27 miles long.

NORTH PLATTE, NEB.—The South Side Mutual Telephone Company has been granted a charter, with a capital stock of $5,000. The incorporators are: J. W. Crow, J. L. Shuck and others.

STAMFORD, NEB.—Articles of incorporation have been filed for the Highline Mutual Telephone Company by I. K. Ashford, Charles Hopper and others. The company is capitalized at $10,000.

LACONIA, N. H.—Articles of incorporation have been filed for the Winnipesaukee Telephone Company, with a capital stock of $180,000, by Jasper N. Keller, of Surrey; Fred W. Story, and William F. Knight, of Laconia, and others

JERSEY CITY, N. J.—The Chester Power Company has been incorporated, with a capital stock of $50,000, by Oscar L. Wild, R. R. Arrington and T. H. Graham. The company proposes to construct and operate street car lines and to supply light, heat and power. F. R. McDermott, 259 Washington Street, Jersey City, is agent.

VINELAND, N. J.—Articles of incorporation have been filed for the South Jersey River Development Company by Elwood C. Potter, Marcus Fry and Winslow W. Walls, all of Vineland, N. J. The company is capitalized at $100,000 and proposes to construct dams to supply water power and to generate electricity.

STANLEY, N. M.—The Stanley Telephone Company has been incorporated with a capital stock of $6,000 to build a telephone line from Stanley to Santa Fé, a distance of 60 miles. The officers of the company are: J. H. Darnell, president and general manager; J. O. Leatherwood, vice-president, and W. C. Scovel, secretary.

ROCHESTER, N. Y.—The New York State Railways has been organized, with a capital stock of $23,140,200, to take over the properties of the so-called Vanderbilt system of electric railways. The company is a consolidation of the Rochester Railway, the Rochester & Sodus Bay and the Rochester & Eastern Rapid Railway companies. The officers of the new company are: Horace E. Andrews, of Mentor, Ohio, president; William K. Vanderbilt, Jr., of Great Neck, N. Y., and John J. Stanley.

of Cleveland, Ohio, vice-presidents; Joseph C. Collins, of Rochester, secretary, and Edward L. Rossiter, of Greenwich, Conn., treasurer.

TOWANDA, N. Y.—The Bradford County Traction Company has been organized by George R. Hill, E. F. Kizer, O. L. Haverly and Edward Whalen. The company proposes to construct a railway system in Towanda Borough, for which it has already secured a franchise. Application has been made to the State for a charter.

HENDERSONVILLE, N. C.—The Appalachian Power Company has been chartered, with a capital stock of $250,000, by George E. Ladshaw, A. L. White, of Spartanburg, S. C., and others to develop a water power on Green River and its tributaries.

THOMASVILLE, N. C.—The Pleasant Grove Telephone Company has been incorporated with a capital stock of $650 by J. E. Meredith, of Thomasville, and others.

HARVEY, N. D.—Articles of incorporation have been filed for the Harvey Telephone Company with a capital stock of $50,000 by R. H. Hamilton, D. F. Siegfried, of Fargo, and A. Peterson, of Harvey, N. D.

McCLUSKY, N. D.—Articles of incorporation have been filed for the Lamont Telephone Company, with a capital stock of $4,000, by Emanuel J. Klundt, of Denhoff, N. D.; Jacob Triebwasser, John H. Regler, of McClusky, and others.

VELVA, N. D.—The Prosperous Farmers Telephone Company has been incorporated to construct a telephone line between Velva and Max. F. M. Mills is president, and H. E. Christianson, treasurer.

ALLIANCE, OHIO.—Articles of incorporation have been filed for the Power & Illuminating Company by Grant Snyder, J. H. Forbush and A. S. Kirkbride, of Salem, Ohio; J. L. Richert, of Leetonia, Ohio, and H. H. Hasford, of Ft. Wayne, Ind. The company is capitalized at $75,000 and has taken over the plant and holdings of the Sebring Light Company. It is understood that the company proposes to furnish electricity to the Youngstown & Ohio River Railroad Company, the Stark Electric Company and other interurban electric railways. The company has a large power plant in West Point, Columbiana County.

CAREY, OHIO.—The Carey Farmers' Telephone Company has been chartered with a capital stock of $10,000 by E. F. Hoy and others.

HARRISONVILLE, OHIO.—The Harrisonville Independent Telephone Company has been incorporated, with a capital stock of $10,000.

MARYSVILLE, OHIO.—The Farmers' Telephone Company has been organized to erect a telephone system in Raymond, Byhalia, York, East Liberty and West Mansfield. The officers of the company are: J. D. Coe, president; C. W. Vanhinney, vice-president; W. N. Plotner, secretary, and W. N. Thomas, treasurer.

WHARTON, OHIO.—The Wharton Telephone Company has been incorporated with a capital stock of $10,000 by G. M. Wichner and others.

OKLAHOMA CITY, OKLA.—The Weeleetka Water Power Company has been incorporated, with a capital stock of $10,000, by C. T. Blake, of Hobart; S. T. Ambler and H. Goffin, of Oklahoma City.

WHEATLAND, OKLA.—The Davis Brothers' Telephone Company has been incorporated with a capital stock of $500 by Jesse P. Davis and A. D. Davis, of Wheatland.

SCHAEFFERSTOWN, PA.—The Schaefferstown Telephone Company has been chartered with a capital stock of $5,000 to construct and operate a telephone system in Lebanon County. S. H. Bomberger, of Schaefferstown, is treasurer.

SHAWVILLE, PA.—The Shawville Rural Telephone Company has been organized and the following named officers elected: Harrison Straw, president; A. B. Lansberry, vice-president, and E. E. Murray, secretary.

DE SMET, S. D.—The De Smet-Mathews Telephone Company has been incorporated, with a capital stock of $3,000, by R. A. Rounseville, Luke Kelly and others.

PLEASANT SHADE, TENN.—The Pleasant Shade Telephone Company has been chartered with a capital stock of $1,000 by G. W. McDonald, G. W. Cornwell, John C. Hesson, J. B. Organ and J. A. Sanderson.

WALLING, TENN.—The Walling Light & Power Company has been chartered, with a capital stock of $5,000, by Jesse Walling, H. R. Walling, E. M. Walling, S. J. Stroud and Samuel Lively.

WICHITA FALLS, TEX.—The Wichita Falls Water & Light Company has been incorporated, with a capital stock of $10,000, by Henry Sayles, J. A. Kemp, Frank Kell and others.

DANVILLE, VA.—The Providence Telephone Company has been incorporated by C. B. Flinttop, of Danville, Va.; D. G. Wilkins, of Blanch, N. C., and others. The company is capitalized at $5,000.

HAYMARKET, VA.—Articles of incorporation have been filed for the Bull Run Telephone Company, with a capital stock of $5,000. The officers of the company are: William Beverly, of Bull Run, president; Leo Howdershel, vice-president, and P. D. Brawner, of Broad Run, secretary and treasurer.

LOVINGSTON, VA.—The Rockfish Telephone Company has filed articles of incorporation with a capital stock of $1,500. The officers are: H. T. Harris, president; J. C. Everett, vice-president, and Thomas Boyce, secretary and treasurer.

ROCKY MOUNT, VA.—The Light & Power Company, of Rocky Mount, has been incorporated, with a capital stock of $5,000, to construct and operate an electric plant. The officers of the company are: N. P. Angle, president; H. D. Dillard, vice-president, and B. L. Fisher, secretary.

FAIRVIEW, W. VA.—The Proctor & Peabody Telephone Company has been incorporated with a capital stock of $5,000 by E. R. Parsons, Albert Garner and J. M. Wells, of Proctor; C. U. Ramsey, of Woodlands, W. Va., and E. C. Yoho, of Welcome, W. Va.

BIENFAIT, SASK., CAN.—The Bienfait Rural Telephone Company has been organized, with A. E. Watt as president and Ira F. Brown, secretary and treasurer, to construct a rural telephone system.

TREGARVA, SASK., CAN.—The Tregarva Rural Telephone Company has been incorporated, with main office in this town.

New Industrial Companies.

THE FOWLER ELECTRICAL SUPPLY COMPANY, of Toledo, Ohio, has been incorporated, with a capital stock of $30,000, by Harry R. Fowler and others.

THE RIDGWAY-McSHERRY COMPANY, of Freeport, Ill., has been incorporated, with a capital stock of $2,500, by F. W. Ridgway, R. J. McSherry and G. H. Luedeking. The company proposes to do electrical construction and repairing work.

THE HUGHSON STEAM SPECIALTY COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $50,000, by E. M. St. John, A. G. St. John and R. G. St. John. The company proposes to do general contracting and construction work.

THE BALL ELECTRICAL COMPANY, of Richmond, Va., has been incorporated, with a capital stock of $1,500, for the purpose of dealing in electrical supplies. The officers are: R. H. Ball, president; A. L. Lucas, vice-president; B. A. Ruffin, secretary and treasurer.

THE LYNN-WIGGINS COMPANY, of Columbus, Ohio, has been incorporated, with a capital stock of $10,000, for the purpose of dealing in electrical supplies. The incorporators are: Harry Lynn, Charles A. Wiggins, Louanna Wiggins, Mary L. Lynn, and Edna A. Lynn.

THE NATIONAL DIETGRAPH COMPANY, of Portland, Maine, has been organized, with a capital stock of $1,000,000, for the purpose of dealing in electrical and other appliances. The officers are: A. F. Dunham, of Portland, president, and M. S. Wells, of Portland, treasurer.

THE NATIONAL CLOCK & ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has been chartered with a capital stock of $100,000 by Theodore H. Wurmb, Robert Baumann, Joseph G. Beckmann and others. The company proposes to manufacture clocks, adding machines, etc.

THE NOVELTY IRON WORKS, of New York, N. Y., have been incorporated with a capital stock of $20,000 by George W. Boyd, of Brooklyn, N. Y.; William A. Ritchie, of Hoboken, N. J., and William Boyd, of Jersey City, N. J. The company proposes to manufacture engines, boilers and machinery.

THE IDEAL AUTOMATIC MANUFACTURING COMPANY, New York, N. Y., has been incorporated with a capital stock of $200,000 to manufacture pumps, engines and governors. The incorporators are: Charles P. McMullen, Victor E. Downer and Edward B. Shoule, all of New York, N. Y.

THE NEW YORK OILLESS BEARING COMPANY, of New York, N. Y., has been chartered with a capital stock of $25,000 to manufacture oilless bearings, machinery and engines. The incorporators are: George Murch and Caleb M. Peellee, of New York, N. Y., and Delphin H. Spicer, of Brooklyn, N. Y.

THE METROPOLITAN SMOKELESS FURNACE COMPANY, of New York, N. Y., has been chartered by Michael F. Burns, of Brooklyn; Solomon M. Schatzkin, of Rutherford, N. J., and Frank L. Burns, of Brooklyn, N. Y. The company is capitalized at $25,000, and proposes to manufacture furnaces, engines and boilers.

THE MARNET CONSTRUCTION COMPANY, of Gloucester, N. J., has filed articles of incorporation with a capital stock of $100,000 for the purpose of doing a general contracting and construction business. The incorporators are: Rollin Morris, of Bryn Mawr, Pa.; J. M. Devlin, of Gloucester, N. J., and Percival A. Wilson, of Philadelphia, Pa.

THE BENN ELECTRICAL CONSTRUCTION COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $5,000 for the purpose of manufacturing and installing electrical apparatus. The incorporators are: William A. Bandbach, Maude E. Hunt, both of New York, N. Y., and Louis F. Benn, of Bayonne, N. J.

THE TRACTION ENGINEERING COMPANY, of New York, N. Y., has been chartered, with a capital stock of $5,000, to manufacture electrical and mechanical apparatus, railroad equipment and dynamos. The incorporators are: C. C. Mann, of Brooklyn, N. Y.; Lewis S. Rough, of New York, N. Y., and Francis N. Dede, of Newark, N. J.

THE CENTURY ENGINEERING COMPANY, of New York, N. Y., has been chartered by Arthur S. Lewis, of Brooklyn, N. Y.; Henry C. Townsend, Jr., of Upper Montclair, N. J., and Edward M. Jellinck, of New York, N. Y. The company is capitalized at $50,000, and proposes to do a general mechanical, electrical, engineering and machinists' business.

THE LONG-DISTANCE LOCOMOTIVE CONTROL COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $20,000 for the purpose of manufacturing electrical and mechanical

devices for signaling or controlling railroads, trains or cars. The incorporators are: Hugo Doab, Arnold Stern, of New York, N. Y., and O. H. Wickham, of Brooklyn, N. Y.

THE WIRELESS ELECTRIC APPLIANCE COMPANY, of Grand Rapids, Mich., has been organized, with a capital stock of $500,000, to manufacture a generating battery and wireless electric lamps, under the patents of Philip Young. The company proposes to erect a plant, but has not yet selected a site. It is said that one of these batteries weighing less than a pound has run a ½-hp motor for about 200 hours constantly. Philip Young is president; Lester B. Markham, treasurer, and H. M. Dunham, secretary.

THE CONSTRUCTION COMPANY GENERAL, of Philadelphia, Pa., has been incorporated with a capital stock of $125,000 to do a general contracting business. The company proposes to take contracts for the construction of electric light plants and water works and sewer systems and other public works, especially in the South. Harry A. Loche, of Philadelphia, Pa., is president; Martin D. Krespach, vice-president; K. M. Denzler, secretary and treasurer, and W. D. Griffith, consulting engineer of the Southern Division. The executive offices of the company are at 547 Drexel Building, Philadelphia, Pa.

Personal.

MR. A. M. LITTLE, formerly with Pass & Seymour, Solvay, N. Y., has resigned to accept a position as general manager of the Mohawk Electric Supply Sompany, of Syracuse.

MR. A. L. HARLEY, chief of the engineering department of the Fort Wayne Electric Works, delivered a lecture March 21 before the Fort Wayne Electric Club on "Dynamos and Motors."

MR. J. F. JONES, formerly of the transformer department of the Fort Wayne Electric Company, has accepted a position in the transformer department of the Wagner Electric Manufacturing Company of St. Louis.

MR. GEORGE A. ILEX, formerly associated with the New River Company at Carlisle, W. Va., is now with the Interborough Electric Service Corporation, 203 Greenwich Street, New York, as its general manager.

MR. HENRY A. LARDNER, for many years on the New York staff of J. G. White & Company, has taken charge as manager of a branch office of that company, which has just been opened in the Alaska-Commercial Building, San Francisco, Cal.

MR. G. D. HENDERSON has resigned as chief engineer and electrician of the Pratt (Kans.) Light & Ice Company, to become general manager of the Eureka (Kans.) Light & Power Company. The latter plant has been purchased by Mr. Henderson and associates and will be thoroughly overhauled.

M. HENRI DELTON, of Paris, France, has associated himself with Mr. C. O. Mailloux and others to practice as electrochemical engineers and experts, under the firm name of Delton, Mailloux & Company, with offices in Paris and New York. M. Delton is widely known in Europe as a successful electrochemical engineer and has there been identified with a number of important electrochemical industries.

MR. HAROLD H. CLARK, lately electrical aide in the Bureau of Yards and Docks of the U. S. Navy Department, has been transferred to the Department of the Interior, where he received the appointment of electrical engineer and was detailed to take charge, in Pittsburg, of an investigation instituted by the Technological branch of the Geological Survey, relating to the employment of electricity in mine work.

MR. H. J. GILLE, contract agent of the Minneapolis General Electric Company, was elected president of the Minnesota Electrical Association at the recent meeting of that body, as noted in our issue of last week. The career of Mr. Gille illustrates the increasing tendency of central stations to recruit their administrative and commercial staff from the technical branch. From the time of college graduation in 1889 to 1895 he was connected with the Acme Electric Company and the Thomson-Houston Company, taking the practical course of instruction in the shops of the latter company at Lynn. After serving as electrical engineer with the Washburn & Moen Company from 1895 to 1898, he became general superintendent of the St. Paul Gas Light Company, during which period he carried out the extensive improvements which have made the electrical plant of this corporation one of the best examples of modern electrical engineering in this country. Since 1907 Mr. Gille has been with the Minneapolis General Electric Company, where his work in improving the methods of street lighting have been particularly noteworthy.

MR. H. J. GILLE.

MR. GEORGE W. CRAVENS has opened an office as consulting engineer in the Fort Dearborn Building, Chicago, and will take up the mechanical, electrical and structural design of power plants for any purpose, the design of special apparatus, either mechanical or electrical, and also undertake the invention and development of new devices when desired. Mr. Cravens has had over 18 years' experience along these lines, a large portion of which was with the General Electric Company at its Lynn and Schenectady works. Since leaving Schenectady he has been with the Goodman Manufacturing Company, Chicago, makers of mining machinery. Mr. Cravens is a member of various technical and scientific societies, is a contributor to the technical press, and is the author of a large number of patentable inventions.

MR. FRED W. INSULL, secretary and treasurer of the North Shore Electric Company, Chicago, has resigned to accept a position with the Northern Idaho & Montana Power Company, in which H. M. Byllesby & Company, of Chicago, are actively interested. Mr. Insull, who is a cousin of Mr. Samuel Insull, is a business man and accountant of unusual ability, and his resignation, due to Mr. Insull's desire to enjoy the bracing climate of the Rocky Mountain region, was accepted with genuine regret. Mr. John H. Gulick, auditor of the Commonwealth Edison Company, has been elected as his successor, retaining all his duties with the Commonwealth company. Mr. E. D. Alexander has been appointed assistant secretary and treasurer of the North Shore company and will execute the active duties of the office. Mr. Alexander has been manager of the Southern District office of the Commonwealth Edison Company, but this office is about to be abolished, the administration of the company being concentrated in the downtown office.

Obituary.

COL. D. H. GARRETT.—We regret to note the death of Col. D. H. Garrett, who had been manager of the Philadelphia office of the Columbia Incandescent Lamp Company, of St. Louis, for the past seven or eight years. He died in Philadelphia on March 19 after a long illness. He was widely known and highly popular throughout the territory he covered, and his death is deeply mourned by a large circle of friends.

WILLIAM HENRY WAHL, secretary of the Franklin Institute, died in Philadelphia on March 23. Mr. Wahl was born Dec. 14, 1848, and, after attending Philadelphia public schools, was graduated from Dickinson College in 1867, and received the degree of Ph.D. from Heidelberg two years later. He became resident secretary of the Franklin Institute in 1870, serving to 1874, and again from 1882 to January of this year, when he was made honorary secretary. Mr. Wahl was editor of the *Polytechnic Review* of Philadelphia from 1876-8; associate editor of the *Engineering and Mining Journal*, 1878-80, and editor of the *Manufacturer and Builder*, 1880-95. He also edited the *Journal of the Franklin Institute* during the long period of his secretaryship. Many years ago Mr. Wahl experimented upon the reduction of refractory oxides by means of aluminum, for the production of carbon-free chromium, etc., thus having anticipated, in a general way, the later alumino-thermic method of Goldschmidt. He was also an authority on nickel plating, his book on the subject having been standard for a long period. As secretary of the Franklin Institute Dr. Wahl was a most thoroughly competent administrator, and much of the success of the Institute during the last generation is to be ascribed to his indefatigable energy and excellent judgment.

Trade Publications.

X-RAY APPARATUS and auxiliary devices are listed and described in a circular issued by the Kelly-Koett Mfg. Company, Covington, Ky.

DIEHL FANS.—The Diehl Mfg. Co., Elizabethport, N. J., has issued Bulletins 22 and 23, covering its line of electric fans for the coming season.

HEATERS of both the electric and gas types are listed, described and illustrated in booklets issued by the Denver Gas & Electric Company, Denver, Col.

ELECTRIC WELDERS for all services are described in an illustrated folder issued by the Toledo Electric Welding Company, 141 Tenth Street, Toledo, Ohio.

GRAPHITE for industrial purposes is treated in an instructive manner in the March issue of *Graphite*, published by the Joseph Dixon Crucible Company, Jersey City, N. J.

THERMIT.—Complete instructions for the use of Thermit in railroad shops are given in a pamphlet issued by the Goldschmidt Thermit Company, 90 West Street, New York.

PORCELAIN for electrical insulation in standard and special forms is illustrated, briefly discussed and listed in a bulletin issued by the Adamant Porcelain Company, Broadway, Va.

ELECTRIC GAS IGNITION.—A. L. Bogart, 123 Liberty Street, New York, has issued an illustrated descriptive price-list devoted to electrical devices for igniting illuminating gas.

INDUCTION CLUTCHES for planers, which operate similarly to induction motors, are discussed in Bulletin No. 102, of the Wheeling Mold & Foundry Company, Wheeling, W. Va.

WESTINGHOUSE TUNGSTEN BULLETIN.—The Westinghouse Lamp Company has issued a bulletin pointing out the advantages and uses of tungsten lamps of the various types.

CENTRIFUGAL PUMPS, designed particularly for use with electric motors, are treated in an interesting and instructive manner in Catalogue T, of the D'Olier Engineering Company, Philadelphia.

TELEPHONES.—Automatic intercommunicating telephones of the all-metal construction are illustrated and described in Circular No. 1103 of the Western Electric Company, 463 West Street, New York.

"HYGRADE LAMPS."—The Hygrade Incandescent Lamp Company, Danvers, Mass., has issued from its New York office, 136 Liberty Street, an illustrated price-list of "Hygrade" metal and carbon filament lamps.

RHEOSTATS.—The American Electric Fuse Company, Muskegon, Mich., has issued a perpetual catalog devoted to Allen-Bradley rheostats and electric controlling apparatus. The rheostats are of the carbon resistor type.

WATT-HOUR METERS for direct-current house service are well described in Bulletin No. 8 of the Duncan Electric Manufacturing Company, Lafayette, Ind. Each part of the meter is illustrated and discussed in detail.

TUNGSTEN FIXTURES.—The Metropolitan Electrical Supply Company, of Chicago, has issued a special catalog, listing attractive tungsten lighting fixtures suitable for residence, store or office use. Many new designs are shown.

MILLING MACHINES.—An elaborately illustrated, neatly printed catalogue of the Miles-Bement-Pond Company, New York, is devoted to heavy milling machines. Almost all of the machines described are arranged for electric motor drive.

WATT-HOUR METERS.—House-type watt-hour meters for direct-current circuits are fully described in Bulletin No. 8 of the Duncan Electric Manufacturing Company, Lafayette, Ind. The bulletin contains much useful information relating to the installation and operation of watt-hour meters.

IRON AND STEEL.—Joseph T. Ryerson & Son, Chicago, Ill., have issued an elaborately illustrated 46-page pamphlet descriptive of their "Iron and Steel Department Store," which is said to carry the most comprehensive stock of iron, steel and allied fittings and specialties in the world.

ROTH MOTORS AND DYNAMOS.—Bulletins Nos. 182 and 193 of Roth Brothers & Company, Chicago, have for their subject steel frame, direct-current dynamos and motors, which machines are made in sizes from 4 hp to 30 hp. Illustrations show applications of the motor to a large variety of machines.

THERMIT.—The Goldschmidt Thermit Company, 90 West Street, New York, has issued a bulletin giving complete instructions for welding castings and forgings by means of Thermit. Vol. 2, No. 1, of *Reactions*, published by this company, contains accounts of many instances of welds made by the Thermit process.

FANS.—Bulletin No. 22 of the Diehl Manufacturing Company, Elizabethport, N. J., contains illustrations and descriptions of direct-current ceiling fans, with and without lamp fixtures. Universal fans, for wall and desk use, with and without oscillators, are treated in Bulletin No. 23. Each of the fans described is listed also.

ELECTRIC RAILWAY.—Bulletin No. 21 of W. S. Barstow & Company, 50 Pine Street, New York, is a neatly executed 24-page publication giving a well-illustrated technical description of the equipment of the Oregon Electric Railway system, which extends from Portland to Salem, a distance of 50 miles, with a 26-mile branch to Forest Grove.

CENTRAL ELECTRIC PUBLICATIONS.—The Central Electric Company, of Chicago, has issued a circular describing its various types of fan motors, particular attention being given to an oscillatory-rotating fan embodying several new features. Other recent publications of the same company are a circular in "New Wrinkle" pull socket, and a trade list of "Opalux" shades.

TUNGSTEN LAMPS.—The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has isued Circular No. 1160, dealing with tungsten lamps designed for a specific consumption of 125 watts per candle. The circular contains an analysis of the cost of energy and replacement for carbon and for tungsten lamps, the results being greatly in favor of the latter.

DIRECT-CURRENT MACHINERY.—The Eck Dynamo & Motor Company, Belleville, N. J., has issued Bulletin No. 39, devoted to protected type generators rated at from 0.035 kw to 15.0 kw; No. 40, dealing with motors of from 0.03 hp to 20 hp; No. 44, relating to worm-geared motors for very slow speeds; No. 46, covering back-geared motors for ratings from 0.08 hp to 20 hp, and No. 47, in which motor-generator sets of from 0.075 kw to 12.0 kw are illustrated, described and listed.

VALVES.—The Nelson Valve Company, Philadelphia, Pa., has issued a 220-page, cloth-bound, neatly illustrated publication as its 1909 catalog of valves. The catalog shows gate, globe, angle and check valves in large variety and of various metals. Among the new features are included the newly patented bronze swing check valves, and hydraulically and electrically operated gate-valves. Steel gate and globe valves for high pressures and superheated steam are listed. Another new departure of note is the list of open-hearth steel fittings. The use of engravings showing both inside and outside views is generous; the descriptvie articles and dimensioned lists immediately opposite the engravings facilitate easy and critical study of each of the valves.

HYDRO-ELECTRIC PLANT OF GREAT NORTHERN POWER COMPANY.—The Allis-Chalmers Company has isued, in pamphlet form, a description of the hydro-electric development of the Great Northern Power Company, one of the largest in the world. During more than 30 years the development of a great water power for supplying the manifold industries at the head of Lake Superior had been seriously considered, and numerous projects, based on the improvement of the St. Louis River, were put forth at intervals. The Great Northern Power Company, as a preliminary to the designing of its works, secured Government records of rainfall for 37 years, and its own gagings of river flow were conducted for a period of seven years, these latter including the most abnormal term of rainfall deficiency that has ever been known, ending in the year 1902. The minimum flow at the date when this drought showed its culmination was about 500 cu. ft. per second. The company took this figure and the period of deficiency which it marked as the basis for calculating the water storage necessary, after arbitrarily increasing the deficiency by 20 per cent. The successful solution of the many difficult problems involved in the construction of this gigantic enterprise makes it one of the notable accomplishments of modern engineering practice.

Business Notes.

THE J. G. WHITE COMPANY, New York, has opened a branch office in the Alaska-Commercial Building, San Francisco, with Mr. Henry A. Lardner as manager.

THE STANDARD UNDERGROUND CABLE COMPANY has removed its New York office from 56 Liberty Street to 50 Church Street, where it occupies a suite on the nineteenth floor.

MR. HAL. C. KIMBROUGH, formerly of the home office at Lockport, N. Y., of the American District Steam Company, is now occupying a responsible position in the Chicago office of the company.

ROTH SALES.—Roth Brothers & Company, of Chicago, have recently sold through their New York sales manager, George F. Schumicke, a large number of motors, including 8 motors for a picture-framing plant and 14 motors for a wood-working plant.

THE SIRIUS COMPANY, 2 West Twenty-ninth Street, New York, is importing a line of flaming-arc electrodes that have met with quite a demand during the short time they have been on the American market. Mr. Ralph Straschnow is manager of the company.

OXY-ACETYLENE CENTRAL-STATION EQUIPMENT.—Mr. W. I. Reich, consulting engineer, 245 West Twenty-fourth Street, New York, has installed in the Twenty-fourth Street shop of the United Electric Light & Power Company, New York, a portable oxy-acetylene welding outfit, which will be used in the company's automobile and truck repair department.

FOX BROTHERS & COMPANY, 126 Lafayette Street, New York, have opened a branch office in the Syndicate Trust Company Building, St. Louis, for the sale of their Polar flaming-arc lamps, Radiant lamps, contact couplings and carbons. T. P. Gleeson, formerly of Smiley & Gleeson, will be in charge of the St. Louis office and will cover the Southwestern territory.

DOSSERT & COMPANY, 242 West Forty-first Street, New York, report having received the following large orders during the current week: From the Compagnie Egyptienne Thomson-Houston, Cairo, Egypt, 500 cable taps and 500 back-connection lugs; from the Western Electric Company, for shipment to Johannesburg, South Africa, 300 front-connection lugs, 200 two-way, 100 three-way and 100 cable taps; from the United Electric Light & Power Company, 2000 flat-shank terminal lugs for service cut-outs.

WILLIAM A. READ & COMPANY, bankers, 25 Nassau Street, New York, announces that the firm agreement expired by limitation March 31, and that Charles Hazard, who has been one of its members, retired from business. William A. Read and Joseph H. Seaman, the remaining members of the old firm, have associated with themselves as copartners John Hallett Clark and John W. Hornor of New York, James Dean of Boston, and W. M. L. Fiske of Chicago, to continue the business under the same firm name.

ANGLE-COMPOUND ENGINES.—The owners of the new Belnord apartment house, at Eighty-sixth Street and Broadway, New York City, one of the largest apartment houses yet built, have recently placed an order with the American Engine Company, of Bound Brook, N. J., for three angle-compound engines, one of 500 hp, one of 400 hp and one of 160 hp. This type of engine is exceptionally adapted to isolated plant work, because of its relatively small space requirements and the entire absence of vibration.

MR. W. P. PRESSINGER, who recently resigned as general manager of the compressor department of the Chicago Pneumatic Tool Company, has organized the W. P. Pressinger Company, to handle the vacuum cleaning machines, both portable and stationary, made by the Keller Manufacturing Company, of Philadelphia, Pa., and formerly sold by the Chicago Pneumatic Tool Company. The new company has opened offices and salesrooms at 1 West Thirty-fourth Street, New York City, and will establish local agencies at all distributing points throughout the Eastern territory.

MR. L. ROBINSON has been appointed manager of the insulating department of the Standard Varnish Works, with headquarters in New York. Mr. Robinson has been identified with the Standard Varnish Works during the past four years. In this period he has spent a great

portion of his time in familiarizing the trade with the exceptional values of the vacuum drying and compound filling process. For fifteen years previously Mr. Robinson held many responsible positions in the operating end of electric railways in the United States, Canada and Europe. With this thorough preparation, and four years' experience in exploiting Standard Varnish Works Insulating Specialties, Mr. Robinson enters his new position thoroughly familiar with the large field with which he has to deal.

MR. J. G. BOYD, formerly traveling in the interests of the Columbia Incandescent Lamp Company in Iowa, Minnesota and surrounding States, has become manager of the lamp department of the Central Electric Company, and will hereafter be permanently located in Chicago. Mr. Boyd has been one of the best known lamp salesmen in the territory west of Chicago for many years, being a prominent figure at the various State electric light conventions and a welcome visitor to many central stations because of his broad knowledge of the small central-station business and the problems which the manager of the small central station has to meet. He is one of the best posted men in the country on voltage conditions as they actually exist of central stations throughout the territory in which he formerly traveled.

NERNST LAMP INSTALLATIONS.—The lighting of the handsome new storerooms to which the John A. Renshaw Grocery Company recently removed, at the corner of Ninth Street and Liberty Avenue, Pittsburgh, is accomplished by Westinghouse-Nernst chandeliers, equipped with 132-watt Westinghouse-Nernst lamps and inverted gas burners. The chandeliers are of the Art Nouveau design, and are finished to correspond with the hardware decorations of the building. The new White House, of San Francisco, which was opened for business Saturday evening, March 13, is lighted by multiple-glower Westinghouse-Nernst lamps in ornamental fixtures. The total installation consists of 1000 glower units. This is one of the finest stores in the rebuilt downtown district, and the opening was attended by no less than 75,000 people. The new First National Bank and the remodeled Dollar Savings Bank, of Youngstown, Ohio, will both be lighted by multiple-glower Westinghouse-Nernst lamps in ornamental housings.

INSTRUCTION OF FACTORY EMPLOYEES.—The Harvard Electric Company has arranged for a lecture course, in order to give its employees a practical idea of electrical construction, especially with regard to cable hangers, wire joints, sectional switch boxes, test connectors, lightning arresters, steel brackets, fuses, cable terminals, conduit boxes, etc., manufactured in the Harvard company's Chicago factory, in their many varied phases, uses and applicability, instead of confining them to the knowledge of the certain parts which each makes. This lecture course is for the exclusive benefit of the Harvard Electric Company employees. It is planned to give short talks after the luncheon hour. At night there will be frequent illustrated lectures. Throughout the course authorities in the electrical engineering field will be called upon. Mr. Allen Lee Haase, sales manager and a "bracket engineer," will discuss all phases of the channel steel bracket and the "reasons why" it is more economical than wood or heavy malleable iron brackets. Mr. Frederic Greer, general manager of the company, will take up more general topics of pertinent interest.

HIGH-VOLTAGE OUTDOOR SWITCHES.—The Kelman Electric & Manufacturing Company, of Los Angeles, Cal., reports having completed its first 30,000-volt self-contained outdoor type of oil switch, which was furnished complete with a 25-foot steel tower and disconnecting switches, to the Globe Light & Power Company, of Visalia, Cal., and that a number of 12,000-volt outdoor type circuit-breakers are nearing completion for the San Joaquin Light & Power Company, of Fresno, Cal. Other orders recently received for standard indoor type of apparatus are as follows: Utah Light & Railway Company, Salt Lake City, Utah, 45,000-volt switches; Pacific Light & Power Company, Los Angeles, Cal., 15,000-volt circuit-breakers; Pacific Electric Railway Company, Los Angeles, Cal., 30,000-volt circuit-breakers; Mt. Whitney Power Company, Visalia, Cal., 30,000-volt circuit-breakers; LaGrange Water & Power Company, LaGrange, Cal., 30,000-volt switches; San Joaquin Light & Power Company, Fresno, Cal., 30,000-volt circuit-breakers; Nevada-California Power Company, Goldfield, Nev., 50,000-volt switches and circuit-breakers; Northern California Power Company, Redding, Cal., 75,000-volt circuit-breakers.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary, Lloyd Lyon, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May 18, 19 and 20, 1909.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, Niagara Falls, Canada, May 6, 7 and 8, 1909.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Hot Springs, Ark., May 12, 13, and 14, 1909.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, 557 Frick Building Annex, Pittsburg, Pa. Next meeting, June, 1909.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Detroit, June 23, 24 and 25, 1909.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, Walter S. Mower, London, Ont.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

ASSOCIATION OF CAR LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next meeting, Chicago, Oct. 5, 6, 7 and 8, 1909.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, S. E. Mumford, Detroit, Mich.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, September, 1909.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC CLUB, CHICAGO. Secretary, W. S. Taussig, 204 Dearborn St., Chicago. Meets every Wednesday noon at Chicago Automobile Club.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 500 Fifth Ave., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 4, 1909.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meetings, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Cincago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., 1909.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., Eng.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Cedar Rapids, Ia., April 21 and 22, 1909.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Cedar Rapids, Ia., April, 1909.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Wichita, Kan., October, 1909.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October, each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Electrical Association. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Jackson, Miss., June 15, 1909.

Missouri Electric Light, Gas & Street Railway Association. Secretary, C. L. Clary. Next meeting, Springfield, Mo., April 15, 16 and 17, 1909.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, John F. Gilchrist 139 Adams St., Chicago. Headquarters, 33 West 39th St., New York. Next meeting, Atlantic City, N. J., first week in June, 1909.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Toledo, Ohio, July 21, 1909.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, Boston, Mass., June 10, 1909.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet Street, New Orleans, La. Meetings second and fourth Tuesday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash. Next meeting, Seattle, September, 1909.

Northwestern Electrical Association. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Canton, Ohio, May 21 and 22, 1909.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Galen Crow, Guthrie, Okla.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York. Next meeting, Pittsburg, Pa., 1909.

Pacific Coast Electric Automobile Association. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting, second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

Society of Wireless Telegraph Engineers. Secretary, C. E. Russell, Boston, Mass. Monthly meetings, fourth Monday of each month.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, J. A. Myler, Jr., 609 Juanita Building, Dallas, Tex. Next meeting, Dallas, Tex., May, 1909.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary,, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester, Vt.

Underwriters' National Electrical Association. Secretary, Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Detroit, Mich., October, 1909.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 23, 1909.

[Conducted by William F. Bissing, Patent Law, 2 Rector St., New York.]

915,741. APPARATUS FOR OPERATING RAILWAY SIGNALS; C. J. Coleman, New York, N. Y. App. filed July 30, 1907. The signal is shifted by means of a gas motor, and the tank which produces the gas (carbon dioxide) is arranged near the signal.

915,768. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed June 9, 1906. A storage battery is used to steady the load with a direct and alternating current system, so that the battery compensates on each of the generating plants. Employs a motor generator between the alternating and direct-current sides of the system, and in the direct-current side utilizes a battery and booster, providing an auxiliary e.m.f.

915,774. COMPOSITION OF MATTER FOR AND PROCESS OF MAKING INSULATING MATERIAL; Carl A. Keller, Chicago, Ill. App. filed Dec. 26, 1907. Mixes hydraulic cement with a waterproofing compound and an insulating asphalt by first mixing cement and sand, then molding and the evaporating, heating and impregnating with asphalt.

915,786. ELECTRICAL PLATING RACK; D. B. Moyer, Detroit, Mich. App. filed March 16, 1908. A cathode hanger for electro-plating, having a conducting rod in a wood sheathing and a detachable conducting branch rod, dipping into the tank.

915,797. GUARD FOR ELECTRIC RAILWAY BONDS; J. J. Sapper and J. G. Brueggemann, St. Louis, Mo. App. filed Aug. 26, 1907. Includes a plate having a flange on three sides forming a chamber, with a pair of horizontal apertures through the plate at its end and a stud integral with the plate within the chamber.

915,824. ELECTRIC HEAD CAP; G. M. Branaman, Kansas City, Mo. App. filed April 25, 1908. For electric treatment of the ear, etc., in which a battery is supported by head gear and ear bobs from the terminals of the battery, the entire apparatus being strapped to the head.

915,846. ELECTRODEPOSITION OF METAL ON HOLLOW ARTICLES; E Friedheim, Paris, France. App. filed March 26, 1907. Deposits on the interior of hollow straight tubes and uses a plurality of conducting rods, connected to a common supporting anode with insulating sleeves and hollow cathodes around the anodes.

915,895. ELECTRIC LOCOMOTIVE; F. L. Sessions, Columbus, O. App. filed Oct. 24, 1903. Electric locomotives for coal mines in which the current is supplied through a flexible cable from the source instead of by fixed conductors. Uses a cable reel which can be actuated from a chain drive and friction clutch from the electric motor.

915,915. ELECTRICAL SYSTEM OF DISTRIBUTION; F. J. White, Brooklyn, N. Y. App. filed Jan. 8, 1906. Storage-battery system in which the battery is regulated by automatic regulation of a booster in series with the battery wheel. Provides a regulating coil for the booster in the battery circuit, so that its current varies in accordance with the variations of current in the battery circuit.

915,951 CONTROLLER FOR ELECTRICALLY DRIVEN PULSATORS; A. H. Gibson, Easton, Pa. App. filed Jan. 4, 1909. A controller for a motor mounted on a vehicle and adapted to compress air which is thereafter supplied to drills. Details in the construction of the rheostat and controller.

915,974. AUTOMATIC THERMO-ELECTRIC CONTROL; H. W. Leonard, Bronxville, N. Y. App. filed Jan. 5, 1906. Particularly for soldering irons, combines with the heated conducting mass which emits heat at varying rates, a resistance device having movable element which automatically supplies heat to the iron, according to the demand.

915,980. PROCESS FOR REGENERATING ELECTRIC ACCUMULATORS; Carl Luckow, Cologne, Germany. App. filed May 9, 1905. Subjects the electrodes to electrolysis in a diluted non-acidic solution.

915,990. JUNCTION BOX COUPLING; E. S. Morrell, Philadelphia, Pa. App. filed Sept. 25, 1908. For attaching conduit pipes to outlet

boxes without requiring screw-threads on the box or pipe. Makes use of clamp-nuts to secure the pipe to the box.

915,993. WIRELESS TELEGRAPHY; J. Murgas, Wilkesbarre, Pa. App. filed May 17, 1907. The antenna extends into the earth and is insulated therefrom and is arranged in a helix. A capacity is arranged on the other side of the apparatus.

916,011. BATTERY CHUTE; C. O. Poor, Rochester, N. Y. App. filed May 18, 1908. Battery chutes for railroad signal work, consisting of a cylindrical tank in the earth below the frost line. The tank has a battery elevator in it to raise and lower the batteries when required.

916,033. PROCESS FOR PRODUCING ELECTRO-DEPOSITS WHICH CAN BE REMOVED FROM THEIR BASE; H. Schmidt, Cologne, Germany. App. filed Aug. 9, 1907. Produces electric deposits, removable from the base, by electro-depositing on a rotary cylinder at an electro-motive force at which no visible alteration takes place and then electro-depositing metal on the first layer.

916,038. TRAIN SIGNAL SYSTEM; H. H. Sharp and W. R. Vanaman, Atlantic City, N. J. App. filed June 12, 1908. For conductors' use to signal the motor man. Indicators are on each platform, and a conducting system, including a circuit controller, is operated by a signal cord.

916,039. ELECTRIC SWITCH FOR SIGNAL CONTROLLING APPARATUS; N. T. Shaw, Los Angeles, Cal. App. filed March 14, 1908. The motorman can operate the switch without leaving the car, the device operating in conjunction with a semaphore signaling system.

916,065. BRUSH HOLDER; W. A. Turbayne, Lancaster, N. Y. App. filed Aug. 8, 1907. The brush is held yieldingly against the commutator, the pressure of the spring acting on the lever, the spring being adjustable to vary the pressure.

916,117. TESTING SYSTEM FOR TELEPHONE LINES; W. W. Dean, Chicago, Ill. App. filed June 29, 1903. The test relay of the system is normally separated from the operator's connective means, so that if one or more of the cords is short-circuited the test relay is not deranged. Instead of severing a strand of the cord circuit, the connection of the strand with the ground is normally opened and closed through the listening key.

916,140. ELECTRIC BRAZING APPARATUS; W. M. Fulton, Knoxville, Tenn. App. filed Jan. 26, 1907. A work supporting horn, a work carrier, an electrically heated brazing bar, which is movable into and out of brazing position, the carrier being controlled by the bar moving means, and the current being cut off from the brazing bar when the latter moves into brazing position.

916,142. COMBINED FIRE-ALARM TELEGRAPH AND TELEPHONE SYSTEM; M. Garl, Akron, O. App. filed July 23, 1907. A series of alarm boxes, a normally closed line circuit and a normally broken ground circuit, with means for cutting a telephone into the line circuit at each of the boxes, and means for placing the telephone at the central in a separate circuit with the alarm-box poles and simultaneously breaking the line circuit.

916,155. ELECTROLYTIC PROCESS; Henry L. Hollis, Chicago, Ill. App. filed Aug. 15, 1907. Process of coating iron sheets with tin by immersing them as cathodes in an electrolyte, viz., a solution of a tin salt of a fluorin acid and a colloid, and causing current to flow through the solution.

916,167. INCLOSED FUSE; P. S. Keefer, Bridgeport, Conn. App. filed Aug. 6, 1908. Has a tubular casing and a metallic cap which closes the end. A blade is secured to the end plate and projects through an opening in the cap.

916,183. FLOAT-CONTROLLED SWITCH FOR FILLING TANKS; S. W. Netherton, Roberts, Ill. App. filed Aug. 9, 1907. For use on tanks into which water is pumped by means of a gasoline engine, which is automatically stopped when the float reaches the top of the tank. Details.

916,220. RAILWAY SWITCHING APPARATUS; J. D. Taylor, New York, N. Y. App. filed April 18, 1904. So constructs the indication mechanism in an interlocking machine that it cannot be affected by currents from the prime source of energy, even though the wires be crossed or grounded. Provides an electric motor and a clutch driven thereby, with a switch and lock operated by the clutch.

916,223. SYSTEM OF ELECTRICAL CONTROL; Percy H. Thomas, East Orange, N. J. App. filed June 19, 1905. For systems in which a vapor electric device is included across a supply circuit, the substraction of the potential from the supply circuit being regulated by the length of the vapor path. The path is varied by tilting or by means of a magnet, and the invention contemplates the application to an alternating-current circuit.

916,235. SUBSCRIBERS' TELEPHONE INSTRUMENT; A. H. Weiss, Chicago, Ill. App. filed Sept. 1, 1904. A desk telephone in which the stand has a hollow base and hollow stem, a bunched set of flat springs for the switch being located in the stem and controlled by a roller on an arm attached to the hook.

916,245. TELEPHONE TRANSMITTER ATTACHMENT; R. L. Woodward, Jersey City, N. J. App. filed Dec. 4, 1908. The operator may close the mouthpiece of the telephone in order to prevent conversations from passing through the telephone by means of a flap valve located in the transmitter to which a finger piece is connected, the latter being on the outside of the transmitter.

916,259. DEVICE FOR CONTROLLING ELECTRICALLY DRIVEN STAGES, LIFTS AND THE LIKE; A. Bohmer, Magdeburg, Germany. App. filed Feb. 21, 1908. The travel of the elevator is automatically limited by breaking the electric circuit at a predetermined height of the elevator. The switch is held closed against the action of the spring by a detent, which is released by controlling means operated from the driving motor.

916,280. FIRE-ALARM SYSTEM; J. Donitz, Leipzig, Germany. App. filed Dec. 28, 1906. A system divided into several sections which normally form a single circuit and are operated from a single battery. Each section is provided with a thermostat, which gives the signal at the central. Details.

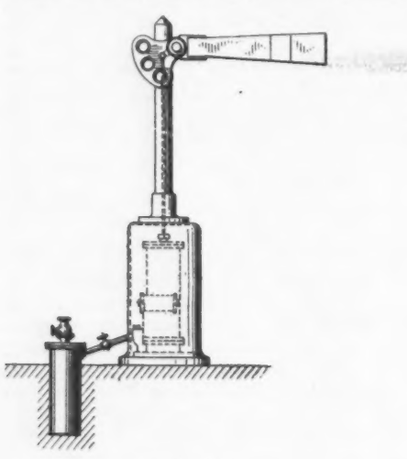
916,284. ELECTRIC SIGNAL BELL; H. W. Eden, Detroit, Mich. App. filed Jan. 9, 1908. Means for securing the insulating parts in a call bell, the latter having a sheet-metal frame and an insulated filler for the opening in the frame.

916,306. LIGHTNING CONDUCTOR AND ANTIHUMMER; Ed Hall, Waterloo Township, Kan. App. filed May 29, 1908. Prevents danger from lightning and the objectionable buzzing. Provides a heavy metallic core, which is secured to the main-line wire through which the current passes, and a yoke consisting of a heavy looped bar around the core, which is connected to ground.

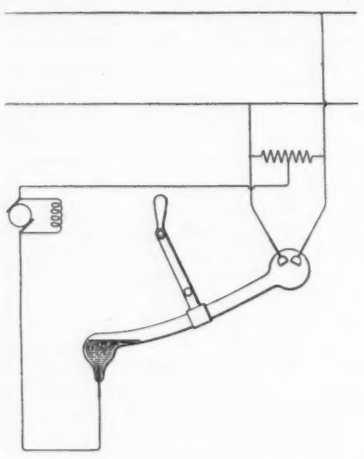
916,313. SPARK PLUG; A. W. S. Herrington, Madison, N. J. App. filed May 7, 1908. Avoids the common dangers of spark plugs by providing a central cable-piercing contact member consisting of a sharp cone which embeds itself into the end of the cable wire and is integral with the central conducting wire forming one terminal of the spark plug.

916,320. SECONDARY BATTERY; H. F. Joel, London, England. App. filed July 17, 1908. Produces a continuous circulation of the electrolyte from the bottom to the top of the cell, thus bringing the dense electrolyte from the bottom into active circulaion.

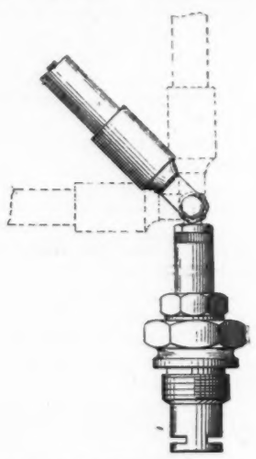
916,321. SECONDARY BATTERY; H. F. Joel, Forest Gate, England. App. filed Oct. 11, 1907. Same objects as 916,320. The electrodes of the cell are flat and are separated by insulating strips inclined toward each other so as to form tapered channels.



915,741.—Apparatus for Operating Railway Signals.



916,223.—System of Electrical Control.



916,390.—Terminal Connector.

916,342. DEVICE FOR PREVENTING ACCIDENTS ON RAILWAYS; J. M. Long, Los Angeles, Cal. App. filed Feb. 4, 1907. When a bumper is struck by a wheel, it closes a circuit so as to give a signal to stop or shut off the current.

916,343. MOTOR-STARTING DEVICE; W. O. Lum, Schenectady, N. Y. App. filed July 18, 1907. By throwing in a single switch the motor is safely controlled by means of an automatic motor starter having a series of contacts, a circuit controller with a bias to starting position, an electrically controlled device for moving the element to running position, and means for de-energizing such device and releasing the element when the latter reaches running position.

916,348. ELECTRICAL HEATER; J. A. Mears, Jr., and C. Ellis, New Rochelle, N. Y. App. filed April 7, 1908. A heater which is thoroughly ventilated and which includes a spirally coiled wire arranged on a ventilated spindle provided with holes.

916,355. ELECTRIC CLOSET APPLIANCE; M. D. Murray, West Homestead, Pa. App. filed Nov. 27, 1908. For medical use. Details.

910,373. POLARIZED RELAY; H. J. Roberts, C. A. Soans and A. H. Graves, Chicago, Ill. App. filed Jan. 25, 1908. Polarized relay in which the movement of the armature in one direction automatically locks one or more switch springs, and the movement in the other direction returns the contact members to normal.

916,390. TERMINAL CONNECTOR; Charles Cuno, Meriden, Conn. App. filed March 28, 1908. A terminal connector for securing a quick and positive electrical connection, and to avoid strains upon wire connections. Particularly useful on gas engines for automobiles.

12,929. TELEPHONE SYSTEM (Reissue); R. H. Manson, Elyria, O. App. filed July 1, 1907. Telephone systems in which a common battery is located at central, in which the transmitter is placed directly in the line and supplied through a coil with many turns around an iron core and the receiver is placed in a Wheatstone bridge, connected so as to avoid differences of potential, except those due to the talking instruments. No condenser or induction coil is used, and the direct current is excluded from the receiver and fluctuating current allowed to pass therethrough.